ELECTRICAL WORLD

A McGRAW-HILL PUBLICATION

MAY 22, 1948

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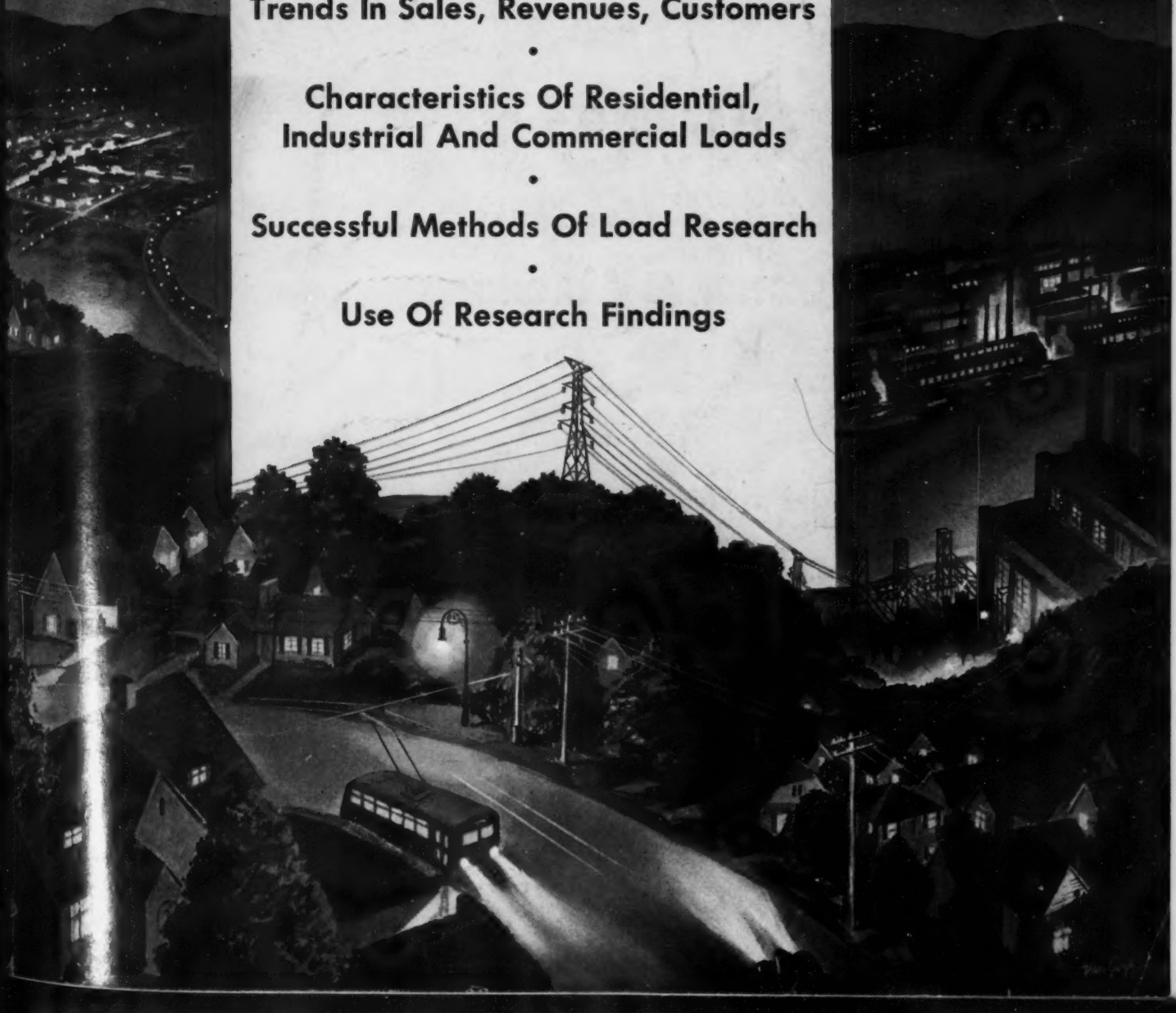
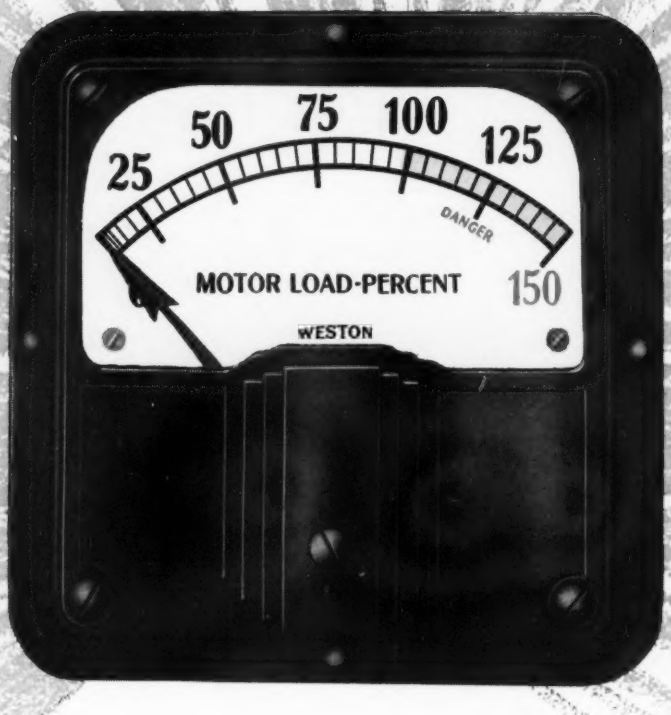
Use Of Research Findings





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ELECTRICAL WORLD

Published for 74 years for those engaged in the business of generating, transmitting, distributing or applying electric power

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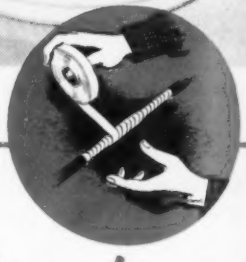

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ELECTRICAL WORLD — Editorials

MAY 22, 1948

Where Were Our Leaders?

TVA's proposal for a steam plant at New Johnsonville has been blocked, at least for this year. The "taxpaying, business-managed" power companies may be grateful for this—but they have no reason to be proud. The blocking was done by men in Congress who evidently are willing to run more risks for free enterprise than are many executives of the private power business.

Three men carried the burden for the industry before the House Appropriations Committee. They were P. L. Smith, president of the National Association of Electric Companies; Philip Sporn, president of the American Gas & Electric Co; and Ray Jackson, a Cleveland attorney. They did their jobs well, believing passionately as they do in the rightness of the principles they stated. A few others happened to be present, one with a statement.

But where were the executives of the other companies most immediately and directly affected by New Johnsonville? Privately, at least, they oppose bitterly steam capacity for TVA. But they failed to do so publicly, where it counted. With a greater direct interest in the matter, they failed to stand and fight to the extent that those Congressional leaders who blocked it dared. This failure will be difficult to expunge.

The excuses for non-appearance hardly seem valid. Do these companies fear retaliatory "raiding" by TVA? Since New Johnsonville was proposed, it has been an industry by-word that the plant was conceived as a device to make "raiding" possible. If New Johnsonville began as a device for "raiding," how could failure to oppose it avert the inevitable? Appeasement hasn't worked yet.

Does one fear that public opposition would lead TVA to cut off existing interchange agreements, without which loads couldn't be carried? TVA wouldn't dare! TVA wouldn't be so stupid. What a mass bloodletting there would be in Congress if TVA forced power curtailments in proved or suspected retaliation for opposition to New Johnsonville! And who can prove that TVA is any less devoted to the great principle of continuous public service than is private power? We have fought and will fight TVA's participation in the power business. But we have no grounds for belief that TVA would inflict a public calamity just to even a political score.

Did various boards of directors forbid executives to appear before Congress, as is known to be the case with at least one company? Then those boards must not comprehend that their long-continued existence depends on the New Johnsonville precedent. If these directors do not know the facts and the implications, then they are not performing the duties and discharging the obligations of their office. The facts are of record—in this publication and elsewhere. And it is widely known that this fight is not really against a steam plant, but against the principle of increasing government competition in the power business—eventually in all business.

Those legislators who blocked New Johnsonville might have found excuses, too. TVA is not an unpopular agency. Yet these men have learned that a planting of courage usually develops a crop of success.

Worth Taking A Look

IS UTILITY plant obsolete? Are working conditions bad in the power business? Are engineers sidetracked by politicians? And can non-technical employees count on working their way past the engineers employed by a power system?

Well certainly, if these things were true, the power business would be a dismal place for the young engineering graduate. And that's just what one of the readers says about the industry. (See Letters to the Editor, EW Apr 24, p 135.)

Making these observations is B. E. Ellsworth, who was listed as an engineer for the Nebraska Public Power System in the 1947 AIEE directory. He cites, and expands upon, the four points mentioned above as some of the reasons why, as he puts it, "Except for a few depression years . . . power companies have always had a hard time interesting young engineers." And he ends with the comment that "The young graduate now has his pick of organizations at a good salary. The electric utilities realize that this condition will not last, so they are biding their time until technical help can be secured at a lower figure."

Three things come to mind upon reading Ellsworth's comments. One is that it isn't hard to think of specific examples of certain of his points. Another is that it could easily be dangerous to generalize so broadly about an industry composed of so many individual companies, with such varying personnel policies and so many different people carrying them out.

But most important, it seems to us, is the need for every executive in the industry who is responsible for personnel, to apply to his own system the Ellsworth yardstick. It would be bad to find any of these charges true on any power system. But how much worse it would be not to KNOW whether they are true or not.

By-Product Of Load Research

DO ELECTRIC UTILITIES KNOW, except in the most general way, how residential customers are using their service?

A national woman's magazine is preparing a series of articles on use of electricity in the homes in various parts of the country. The editor asked a number of power companies for names of residential and farm customers with homes well equipped electrically. Many companies did not know any homes that met the specifications of the editor as possible story material.

The utilities approached have large sales per residential customer. They are outstanding in promotion of residential and farm load. Undoubtedly they serve many homes about which articles could be written. But very few could tell the editor where to get the kind of story wanted. Here was an opportunity for effective publicity on the theme of electrical living. Not many companies were able to rise to it.

In this issue is a series of articles on loads and load research. There is nothing in them about the publicity value of load research results. But the incident here related shows that such value does exist as a by-product of the principal objectives—system planning, rate determinations, and load development.

Tip To Management

FOR YEARS, agitation has been carried on aimed at junking the discriminatory taxes on oleomargarine. These levies, which take the form of license fees and direct taxes on the product, were instituted and supported most effectively by dairy farming interests. The dairy people, of course, had the powerful support of the farm bloc.

It took the scarcities of a war and the high prices of a postwar inflation to put over the repealer. Now, on the word of GOP Congressional leaders, Congress, at least, will kill the oleo taxes. After a generation, you might say, the oleo lobby has worked itself out of a job. Discrimination shall be no more in the bread-spread business. Now if the oleo boys are smart, they won't have to look far for another "anti-discrimination" issue.

Let's Face It

FOR SOME TIME NOW, the power business has spent most of its time talking about and worrying about and doing something about its capacity to render service. But there's always time for a look at the remainder of the broad electrical industry.

The following was published recently by a sister McGraw-Hill paper, *Electrical Construction and Maintenance*. It began with a flat concession that, so far, domestic space heating by electricity doesn't make any economic sense. Then it goes on:

"Why not face it? Maybe electric space heat is a luxury. So's your wife's new spring hat and all that shiny chrome on your car. The people of this country have a notorious history of ignoring the engineer's vigorous concept of economy. Once electric heat strikes the public imagination, no btu vs kwhr comparison will long delay it.

"Today we can see only the distant outlines of an enormous potential market. The immediate foreground is cluttered with irksome realities. Present wiring systems certainly cannot tolerate added kilowatts. Generating capacity and distribution is making slow headway trying to forge ahead of already existing demand. But neither long-range utility planning nor present wiring practices seem to include the capacity requirements that would be necessary for more than a modest increase in auxiliary heating. Why? Don't we believe in the future of our industry?

"The rate of growth of electric heating may be slowed by its luxury status. But luxuries can become necessities in our economy with awful suddenness. We may have a bear by the tail."

NEWS OF THE ELECTRICAL WORLD

The Electrical Week

A Senate committee finally pulled the plug on utility legislation for this year when it turned down the Moore-Rizley bill amending the Gas Act. The Miller bills, to amend the Power Act, never got as far as did Moore-Rizley . . . Washington is doing a lot of talking about allocation of scarce industrial materials. So far, action isn't to be expected . . . In Colorado, the annual meeting of the American Public Power Association heard a revival of the suggestion that federal power developments be financed by revenue bonds. Continuity of funds seems the principal justification . . . And in Pittsburgh, operators of Pennsylvania power systems debated the twin evils of delaying maintenance or imposing load curtailments.

If the Republicans win the White House and Congress in November, REA will have to explain next spring why it has a large carryover of loan funds from 1948 and '49 authorizations. The agency's best friends are telling it that it can't possibly lend out presently available funds, plus $400,000,000 for 1949, by July of next year.

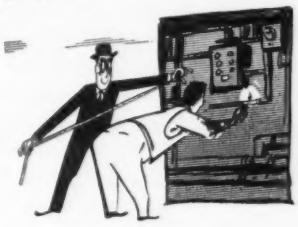
Twist-of-the-week-dept: Tennessee's Rep Gore charged that those who would slash TVA's budget by the $4,000,000 sought for New Johnsonville are proposing a "Morgenthau Plan" for TVA. What an epitaph for the Treasury's greatest spender!

Thought-for-the-loadbuilders dept: Union Electric isn't at all unhappy about the inrush of television sets on its system. Each five sets, UE figures, is the equivalent of a new residential customer, and at practically no expense to the company.

Westinghouse Electric International has just completed financing of a $2,000,000 rehabilitation job on Taiwan's transmission and distribution systems. Contracts have been signed. Deliveries are to start within three months.

Here's a story that's puzzling some of the people who passed on these shipments during the war. In 1944, the U. S. shipped Russia 150 diesel-electric locomotives. No spare parts were sent with them, but a list of parts available was sent. Six months ago, the Baldwin Locomotive Works got a request from Russia for parts for these locomotives. Baldwin replied, asking more details. It's had no answer since. The point is made that Russia couldn't possibly have used the locomotives all this time without needing spares. The question is: What've the locomotives been doing all this time, standing idle?

A Connecticut jury has ruled that a gas company is not to blame if a customer goes looking for a leaking pipe with a match—and finds it. The jurors probably couldn't recover from their surprise that there was anyone left to bring suit.



Those pushing the Middle South Development Program anticipate a certain amount of unintended assistance from the Munitions Board. They credit it to the continuing desire of the military to locate important war facilities away from the areas most likely to attack in another war.

Why-operating-men-get-gray-dept: If its load estimates are as little as two percent on the low side, one operating company will have a critical capacity situation as late as 1951, despite everything it can do to get capacity in by that time.

Mexico City's Electrical Workers Union, seeking nationalization of the Mexican Light & Power Co, demanded a 60% wage boost and other benefits. It offered to drop wage demands if the company were nationalized. The government which would nationalize under such circumstances probably would be tempted to nationalize the union, too, in self-defense.

President Truman has directed the State Department to study the possibility of converting the abandoned 'Quoddy tidal power project into an international development. A hard winter, starting with a big freeze in early November, probably will kill it.

No Changes This Year in Federal Utility Regulations; Gas Bill Shelved

NOT THAT there was much doubt about the matter, but a Senate committee last week (May 13) wrote the obituary—for a year at least—for all proposed changes of federal utility regulation.

Prospects for such legislation, including proposals to amend the Federal Power Act, were formally killed when the Interstate and Foreign Commerce Committee shelved the Moore-Rizley Bill to revise the Natural Gas Act. The 13-man committee includes only six Democrats, but the bill was tabled by a 9-4 vote.

Why at least three GOP Senators "left home" on this particular issue was clearly defined by Sen Clyde Reed, Kansas Republican. Senator Reed noted that Democratic spokesmen had predicted enactment of the Moore-Rizley Bill would result in substantial increases in residential gas rates. He said the President probably would veto the measure on those grounds. Republican sponsorship of the bill would give the Democrats a "first class political issue in a campaign year," he pointed out.

Chief feature of the Moore-Rizley Bill was a proviso allowing interstate pipe line companies a commodity (field) price of gas which they own or produce themselves. Under present FPC regulation, the companies are allowed only "original cost" for such gas in their rate calculations.

Similar apprehension over the "utility issue" apparently has stalled House bills to amend the Federal Power Act (by Rep William Miller, Connecticut Republican) and to revise Section 5 of the 1944 Flood Control Act (by Rep George Dondero, Michigan Republican). Extensive hearings were conducted last year on both measures.

Miller told ELECTRICAL WORLD that he had little hope for House floor action on his power act amendments this year. He was still hopeful, he said, of favorable committee action this session.

Meanwhile, some industry advisors to the National Security Resources Board's Utilities Section were casting about in vain for a sponsor of what they termed "an urgently needed defense measure." Their proposal, in brief, would permit establishment and limited use of widespread interconnections of electric utility systems without subjecting the companies involved to FPC regulation.

The authors of this plan made it clear they were not acting for NSRB or any other defense organization. But their studies had made clear, they said, that there would be a necessity for considerably greater interconnection of power systems in the event of another national emergency. At least two Congressmen have refused to introduce the proposal in legislative form because it might touch off an anti-utility row.

Electrical World Photo by Heston

L. T. MERWIN, right, president of Northwestern Electric Co when it merged last year with Pacific Power & Light Co, poses with PP&L President Paul B. McKee. The occasion was the renaming of PP&L's Ariel Dam in Clark County, Washington, in honor of Merwin

•

NFPA Forms Electrical Section to Handle Code

New procedures for revision and administration of the National Electrical Code provided a major item of business at the annual meeting of the National Fire Protection Association in Washington last week.

NFPA's new Electrical Section was organized for this purpose, with Alvah Small, president of the Underwriters' Laboratories, Chicago, as chairman. The new group succeeds, and takes over the duties of, NFPA's old Electrical Committee and Electrical Field Service Committee.

The new Electrical Section was set up, association officials explained, to "secure a broader basis for development of successive editions" of the code and to provide "a forum open to all those interested." Its secretary is Charles L. Smith of Detroit, recently appointed electrical field engineer for NFPA.

Chairman Small said that actual code-making functions of the new section will be performed by several committees, which will be under the general direction of an electrical correlating committee.

The latter body is composed of Small; Smith; George Andrae, Milwaukee contractor; E. A. Brand, Buffalo Niagara Electric Corp (or O. K. Coleman, Lafayette, Ind., consulting engineer as alternate); M. M. Brandon, Underwriters' Laboratories, New York; L. W. Going, Portland, Ore., electrical inspector; Richard L. Lloyd, National Bureau of Standards; James W. Lynett, New York Board of Fire Underwriters; August H. Schirmer, Bell Telephone Laboratories; George L. Swan, National Board of Fire Underwriters; Frank Thornton, Jr., Westinghouse Electric Corp.; E. E. Turkington, Associated Factory Mutual Fire Insurance Cos.

Members of the correlating committee were selected "on a personal basis, rather than as representatives of organizations," NFPA officials said.

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Now Columbia Gas System

Columbia Gas & Electric Corp, which has disposed of its electric properties, has changed its name to Columbia Gas System, Inc.

Talk, and Just Talk, Is Allocation of Scarce Industrial Materials

ALLOCATION OF scarce industrial materials, including steel and other metals, again is being talked in Washington. But it's still just talk.

Important Congressional sentiment is forming in behalf of some form of controls. The President's advisors are drawing up several plans for revision of the voluntary allocation program.

Idea behind all this thinking is that the government soon must take steps to prevent a mad scramble for raw materials. The voluntary program was set up to insure the government's commitments for foreign aid and national defense and to take care of key industrial expansion. These needs alone, it has been estimated, will take more than half the nation's steel production, for example. And the voluntary allocation program is not even doing that job.

Best bet among the plans being formulated by administrative agencies is a scheme to amend the voluntary allocation law to permit almost unlimited industrial agreements. This would eliminate existing anti-cartel provisions of the existing law. Thus, the Justice Department would not be allowed to veto allocation agreements it deemed "monopolistic." Nor would public hearings be held on all allocation plans, as now required.

Truman aides hold that anything further than conservative modification of the existing voluntary allocations would be politically impossible at present. Nonetheless, the White House may again ask for real government rations, along WPB lines, with the full knowledge that Congress would not go along.

Behind the present planning for controls is the sweeping plan drawn up by the National Security Resources Board, which would set up full controls for future use in event of war, plus some immediate allocations of scarce materials. Accent of this proposal was on obtaining requirements of the military. It has been rejected by Mr. Truman.

Most talked of scarcities are those in steel and the major non-ferrous metals. These would get first attention under any revision of the Voluntary Allocations Program. Key industries, including the electric utilities, probably would get high priority for equipment, with steel and other materials being channeled to electrical manufacturers.

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Buys Power Plant Site

Indiana & Michigan Electric Co has acquired land along the Ohio River in Dearborn County, Indiana, just outside Lawrenceburg. A 185,000-hp power plant will be erected on the site.

HARTFORD ELECTRIC LIGHT CO breaks ground for an addition to its South Meadow Station. A 45,000-kw unit is to be added. Reconstruction and enlargement of the company's mercury vapor turbine and boiler will add another 20,000 kw to capacity this year. When all installations are complete, station will have a capacity of 230,000 kw. Left to right are Carleton F. Sharpe, Hartford city manager; Samuel Ferguson, chairman of the board; Dwight Douglass, superintendent of power; Austin D. Barney, president of the utility; and Cyril Coleman, mayor of Hartford. Stone & Webster is general contractor

Utilities Common Stocks to Become More Popular

Confidence that common stocks of utilities will rise in investor favor was voiced by Edward Schickhaus, Newark banker, at the spring meeting of the New Jersey Utilities Association, May 14 at Seaview. Industrial equities are now more attractive to investors because of the present high-price level. This attraction will lose strength, and utility common will gain in comparison when prices recede.

"A utility is entitled, in the eyes of the law, to a reasonable return in bad as well as in prosperous times, during periods of high prices as well as when prices are depressed," said Jack Schwarts, deputy executive officer of the New Jersey Commission. This statement was immediately preceded in Schwarts' paper by reference to a U. S. Supreme Court dictum that the function of a utility commission is to apply the law.

Little margin is left for improvement in electrical equipment in terms of efficiency, said Frank R. Benedict, Westinghouse Electric Corp. Future progress must come mostly from reductions in size and cost by use of new materials in revised designs. Benedict told how the silicones and Fosterites were changing the insulation picture, how molecular-oriented steels were affecting magnetic circuit designs, and how new casting techniques have made it possible to utilize the high temperature characteristics of modern alloys in prime mover design.

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U. S. Acts to Collect Back Taxes from Viv Kellems

The government has accepted the defy of Miss Vivien Kellems who has refused to collect withholding taxes from her employees.

Last week (May 13), the Acting Collector of Internal Revenue for Connecticut filed a lien in the Town Clerk's Office at Westport for $1,685 against her real and personal property. The sum represented $837 which the government said was due for the first quarter, 100% penalty, plus interest.

Miss Kellems, who heads the Kellems Co, manufacturer of cable grips, said she will fight the government's action. She had invited the government to indict her as she claims that she has no right to deduct the taxes from her employees. Miss Kellems has been paying them in full and advising them to pay the government as she is no tax collector.

Revenue Bonds to Finance Federal Hydroelectric Projects Suggested

REVENUE BOND financing of federal hydroelectric projects and changes in ratemaking practices were major discussion points as the American Public Power Association met last week at Colorado Springs, Colo.

Samuel B. Morris, general manager of the Los Angeles Department of Water & Power, advised that revenue bond financing of federal hydro projects which have been guaranteed by power contracts should be given serious study. In addition the complex legal, political, and financial problems should be attacked without delay. Authorizations and appropriations for these self-liquidating water power projects are now lagging in an unfortunate and critical manner.

Federal agencies in complete control of the country's great rivers, Morris said, have mapped large programs. But national policy and Congress have not implemented them with funds. Generation of vitally needed hydro energy has become involved in political maneuvering. In many cases, it is threatened with the burden of irrigation projects which cannot carry their own costs.

Morris called for a reinstatement of the policy under which Hoover Dam was built, wherein financing was made possible by guaranteed revenue from power contracts. He would go a step further and finance by United States revenue bonds against power revenues.

Though Sen Harry Cain of Washington is reported to be considering the introduction of a bill in Congress to provide for the financing of present and future self-liquidating reclamation projects, as well as such portions of broad multipurpose projects as are determined to be self-liquidating, Morris did not favor the consolidation of all such projects. He feared that some weak and uneconomic projects would be carried along.

Morris asserted that if repayment with interest were guaranteed by contracts and revenue bonds issued on each project, a new element to judge the economic soundness of the projects would be introduced. The new element would be the investing public. The confidence of investors in sound projects should give confidence to Congress. This in turn should lead to adequate funds for them.

Speaking as an individual and not as an employee of the Federal Power Commission, Charles W. Smith traced the history and developments in ratemaking. The chief of FPC's Bureau of Accounts, Finance, and Rates took the stand that fuel adjustment clauses are inappropriate for residential rates.

"Regulation of rates is not a precise thing," he said. "Return fluctuates. There is invariably a margin of profit over a fair return for a reasonable period of time before rate reductions are made. This margin should be absorbed before rate increases are inaugurated.

"Accordingly, it is my view and this applies to all escalator clauses, that it is better to adjust residential and commercial rates as the earnings situation requires or permits rather than to increase or decrease such rates automatically when a large item of expenses changes."

Smith added that he favored fuel clauses in industrial and wholesale electric rate schedules where large volumes of energy are sold in competition with other fuels at comparatively low rates. "Where the volumes are large and the margin of profit small, expeditious adjustments are necessary when a large item of expense sharply changes. If this is not done, a loss may result which may likely be borne by other, particularly the residential, consumers."

GULF POWER CO gets rid of its Pensacola, Fla., gas properties by selling them to the city for $1,891,977.64. SEC had ordered the divestment. James F. Crist, seated at the left, Gulf Power president, gets the check from City Manager Oliver J. Semmes

PSC Rate Order Loses in Wisconsin High Court

Wisconsin's Public Service Commission "spelled out the Hope case several steps further" than the U. S. Supreme Court did when it decided the Hope case. That was the finding of the Wisconsin Supreme Court last week (May 12) when it affirmed a lower court ruling which last fall junked a Wisconsin PSC rate order that set rates for the Commonwealth Telephone Co on a "no-rate-base-no-rate-of-return" formula.

The state high court added that the WPSC, having stretched the Hope case beyond the U. S. Supreme Court's words, had "determined to keep the entire basis (for its decision) a secret." The Wisconsin court pointed out that any court reviewing a rate or order so determined could not determine whether a given profit is proper unless the Commission spells out how it determined the profit. It noted that a reasonable profit might be $12,500 one year and $25,000 the next, and added:

"It was not the intention of the legislature to bestow such arbitrary powers upon the Commission, and nothing in the situation can be so construed . . . The present method of the Commission (in determining rates) is improper and must be abandoned."

Will Spend $9,500,000

Seattle will spend $9,500,000 developing its Gorge hydroelectric project. Work is to begin immediately and continue for three years. Largest unit of the program is an addition to the powerhouse and installation of another 66,700-kva generating unit. Including auxiliary equipment, the cost will be $4,314,505.

MEMBERS of the Systems Operation Committee of the Pennsylvania Electric Association at their meeting at New Castle

Maintenance of Station Equipment Raises Problems for PEA Utilities

PLAGUED BY fuel shortages and still-dwindling reserves of generating capacity, utility system operators this summer face the dilemma of again postponing long-delayed maintenance of station equipment or imposing load curtailment measures. In some cases, both may be necessary.

The problem dominated discussions at the meeting of the Systems Operation Committee of the Pennsylvania Electric Association at New Castle last week.

A survey of station maintenance practices of 26 utilities in Pennsylvania and neighboring states, made by R. N. Youtz, Pennsylvania Water & Power Co, showed that about a third of the companies have decreased their pre-war frequency of turbine overhaul by amounts ranging from 30 to upwards of 60%. In most cases, the decreased frequency has brought an increase in the time required for overhaul. Outage days required for normal overhaul, with work done on a one-shift-per-day basis, varied with the type and size of the unit. Among the 26 companies it ranged from 12 days to as high as 70 days for units in the 30,000 to 60,000-kw range. Turbine availability, however, averaged in the high 90's ranging from 80 to 99%.

Frequency of boiler overhaul for units without refractory walls ranged from 6 to 24 months, 4 to 12 months with refractory walls. Boiler outage time on a one shift-per-day-basis, ranged from 6 to 40 days. Availability was slightly less than for turbines. Both frequency and outage time varied widely with size of unit, pressure, and in some cases length of turbine outage.

Limited use of induction voltage regulators on the Pennsylvania Power & Light Co system places the burden of voltage control on substation busses. Method of system voltage control used, as described by Parker J. Davies, consists of operating synchronous equipment and tap changing under load at attended stations under a voltage schedule tailored to the shape of the load curve. The scheme requires no supervision from the system operator unless it is impossible to hold to the schedule with available equipment.

A. R. Deck, Metropolitan Edison Co, reported that 73.7% of total transient faults on the 33-kv and 66-kv systems of Metropolitan Edison and the New Jersey Power & Light Co have been cleared successfully by existing Petersen coils.

O. E. Lang, Pennsylvania Electric Co, reported that a $1,250 heat pump at the load dispatchers office in Erie to date shows an operating cost of about $22 per month or ¾ cents an hour using electric energy at 2 cents per kwhr. It heats 9,100 cu ft using 9 to 10 gpm of water at 51 deg, cooling it to 34 deg.

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Condemnation Suit Ended

Following a recent Arizona Supreme Court ruling declaring void a state statute of eminent domain as applied to condemnation of public utilities, a four-year-old federal court suit by the City of Tucson to acquire properties of the Tucson Gas, Electric Light & Power Co has been dismissed.

System Underground

Consolidated Edison Co of New York has 21,085 miles of electric light and power cables under the streets of Manhattan and the Bronx alone.

Northwest Group Gets Advice on What to Do

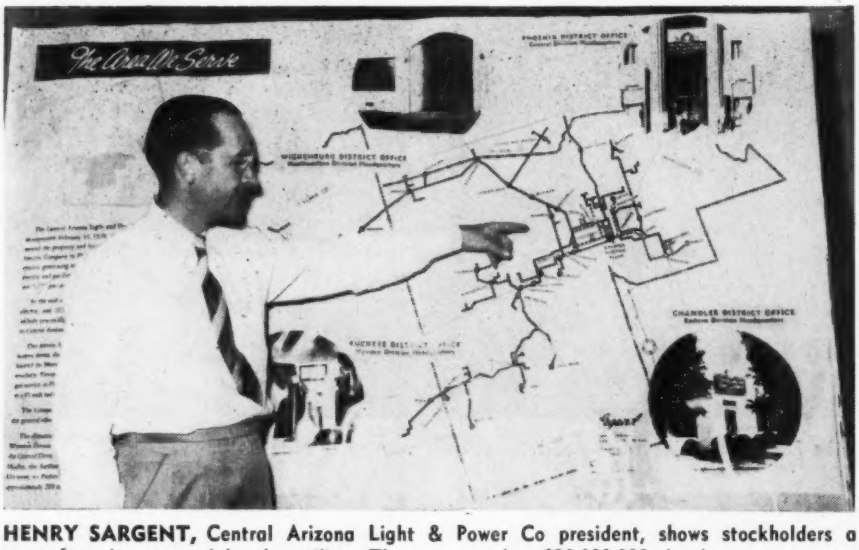
"Here is what must be done; do it" was the attitude of most of the speakers at the meeting of the Business Development Section of the Northwest Electric Light & Power Association. The meeting was held at Victoria, B. C., May 10-12. Attendance of 350 came from five Northwestern states and two Canadian provinces.

Some of management's headache-making problems were listed by W. L. Thrailkill, assistant general manager, Washington Water Power Co. Among them were the sales dilemmas: How to sell so as to derive net revenue when there is no surplus generating capacity to sell and how to mold load as a preventative of power curtailment. He listed a dozen other problems of dealer and sales policy which he asked the group to study and advise management.

W. C. Mainwaring, vice-president, British Columbia Electric Railway Co, advised the industry to quit fooling around and really do something about wiring. "What the industry has done so far is pitiful. It needs real money and energetic effort. It can best be done through an all-industry organization, such as a league, well supported financially."

Stressing industry interdependence, P. L. Lowry, field director, National Electrical Contractors Association, reminded that the reformers are out to eliminate wholesalers as "parasites" and contractors as "robbers" as well as utilities as "monsters". "But how long will there be a supply of competent electrical mechanics to install the electrical equipment you wish to serve if your support is not given to the qualified contractor?" he asked.

Robert Gros, advertising and publicity manager, Pacific Gas & Electric Co, San Francisco, told the advertising committee how not to get "caught with your kilowatts down" as his company



HENRY SARGENT, Central Arizona Light & Power Co president, shows stockholders a map of territory served by the utility. The company has $20,000,000 development program

had been during the recent California drought-induced power shortage. His advice was to be sure to forewarn the public and ask its aid—not wait until the crisis crystallized.

The Northwest power situation was summed up by A. E. Grauer, president of the B. C. Electric Railway. He said the utilities can see the situation through if two things are done: 1. State and local governments make up their minds on a clear-cut power policy so that private companies can likewise know where they stand. 2. Regulatory bodies set a definite policy on rate of return so that capital for plant expansion to meet growth can be attracted.

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Central Hudson Settles Claim Against N. Y. City

Central Hudson Gas & Electric Corp has settled its claims against New York City for the diversion of Rondout Creek in Ulster County. Under the settlement, Central Hudson will receive 160,000,000,000 cu ft of water in 50 years. At the end of that period, the utility will transfer to the city a power plant, substation, and other equipment to be erected at Grahamsville.

The dispute started over five years ago when the city acquired by condemnation the right to divert head waters of the creek. In the same manner, the city took the water rights of the utility on Rondout Creek from the vicinity of High Falls to the Eddyville Dam. When the city began to divert water in 1944, the utility was deprived of water at its Honk Hill and High Falls Plants. Other potential power sites on the Rondout below High Falls were reduced in value.

The water which the utility is to use will come from the aqueduct which the city is planning to build.

PG&E Hits Reclamation Must-Wheel Power Plan

The federal government's demand that Pacific Gas & Electric Co wheel power to government agencies "is not authorized by federal or state laws and would be contrary to the federal reclamation law," a recent statement by PG&E officials declared.

The statement of the company's position was made following a complaint filed with the California Public Utilities Commission early this month.

The demand "represents another attempt on the part of the Bureau of Reclamation to force the company to convey power to customers the Bureau hopes to take away from the company," the utility said.

"The Bureau seeks in this manner to establish the destructive tax-free power system in California which Congress has consistently refused to authorize.

"The Bureau's claims were fully refuted before the California Public Utilities Commission last March at a hearing on disposition of power from a new unit at Shasta Dam. At that time the Bureau attempted to use the pressure of a power emergency as a club to force this unreasonable conveying position on the company.

"The Bureau's position was so unsound that it finally receded and is now delivering power to the company from the new unit at Shasta on a day-to-day basis.

"The company has been purchasing the power output from Shasta from its beginning on June 26, 1944, and from the Yosemite plant since Nov 20, 1928. Purchase from these plants is made under contracts with the government which do not include any such conveying position."

Canadian Output Falling as Primary Usage Rises

Output of Canadian central stations continued to fall during February. The 3,499,238,000-kwhr total was the lowest of any month since September, 1946. At the same time consumption of primary power was setting another record. The 3,177,434.000 kwhr total was the highest ever recorded in February.

Gross exports to the United States dropped to 122,485,000 kwhr. It seems certain that the exports, which reached 2,646,435,000 kwhr in 1945, will fall below the two billion mark this year.

Restrictions on the use of power because of lack of water which prevailed in February have now been lifted. However, output for the first two months of 1948 was 187,318,000 kwhr behind output for the corresponding period of 1947. This deficit will have to be made up before the utilities can think of breaking their record of 44,986,364,000 kwhr, made in 1947.

The following statistics, supplied by the Dominion Bureau of Statistics, are in thousands of kilowatt hours

Period	1948	1947
Two months	7,252,984	7,440,472
Primary	6,786,966	6,191,766
Secondary	466,018	1,248,706
Exports to U. S.	238,769	319,949
February	3,499,238	3,589,361
Primary	3,277,222	2,981,700
Secondary	222,016	607,661
Exports to U. S.	109,841	151,786
January	3,753,916	3,851,111
Primary	3,509,914	3,210,066
Secondary	244,002	641,045
Exports to U. S.	128,928	168,163

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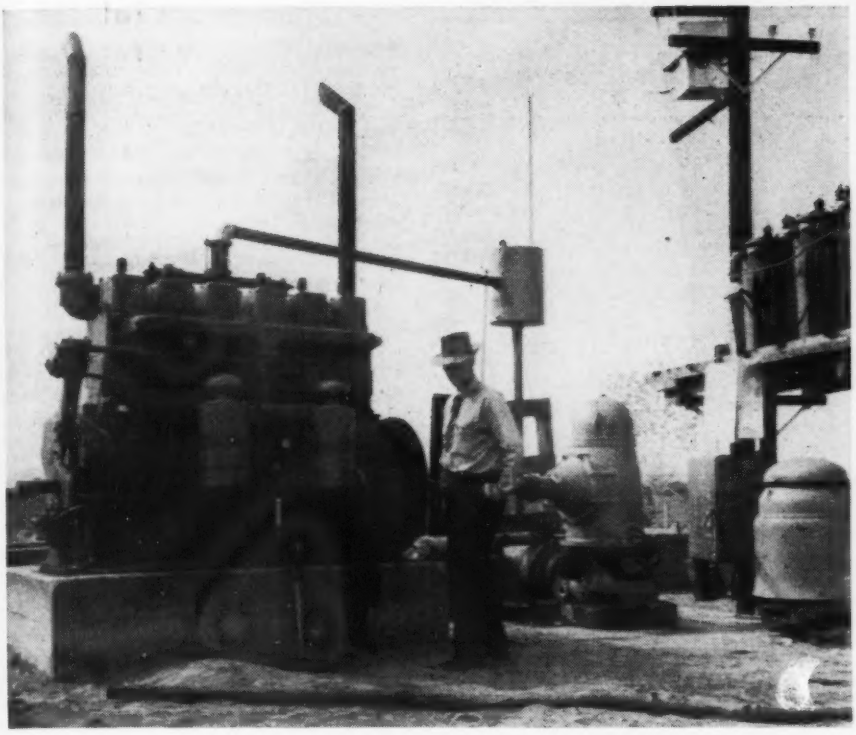
All Power Restrictions in California Suspended

Controls on new industrial loads, last remaining power restriction enforced in Northern and Central California, were suspended May 1 by the Public Utilities Commission.

Unusually heavy rains in March and April, deliveries of power from Southern California, and installation of new generating equipment were factors permitting complete removal of controls, Robert P. O'Brien, emergency power director, said. Electrical power storage for the area reached 1,091,100,000 kwhr on Apr. 26, as compared with the low of 773,000,000 kwhr on Mar 13.

Although many reservoirs in the area remain below the levels of 1947, a dry year, Shasta has swollen to 3,707,000 acre-ft, only 7,000 acre-ft below capacity. State Engineer Edward Hyatt predicted that Sacramento Valley watershed runoff will reach 70% of normal over last year's 56% and that the San Joaquin Valley runoff should be 60 instead of 49% of normal, as in 1947.



GAS ENGINES are replacing electric motors for driving pumps in water-short and electricity-short Central Arizona. Scores of the engines, costing $13,000 each, have been installed in the Queen Creek and San Carlos Irrigation District areas

Gas Engines Replacing Motors for Pumping Use

Gas engines are replacing electric motors for irrigation pumping purposes in the Queen Creek and San Carlos districts of Central Arizona. Drought and the inability of power companies to guarantee a supply of firm power have caused farmers to make the change to natural gas.

In the Queen Creek area alone, 23 of the 80 pumps in the district have converted to gas. The combined capacity of 4-in. main lines installed by the Central Arizona Light & Power Co and by a gas line company, will be sufficient to operate 50 large pumps.

Conversion came after officials of the Salt River Valley Water Users' Association had curtailed power consumption by 40% with warning it might go as high as 50%.

Farmers have more than $439,000 invested in the 23 gas-burning engines and the 26 miles of main line pipe. They will get back $140,000 of the cost of the lines in 10% deductions from monthly bills.

The big gas engines, manufactured by the Natural Gas Engine Co, Waukegan, Ill., are rated 200 hp and cost $13,000 each. They replace electric motors putting out 145 hp.

Nearly all pumps in the area work 3,500 hours a year and some operate as high as 4,000. Farmers estimate that the gas power is cheaper than electricity. Upkeep of the engines, however, is costly. Repairs are figured at $400 a year, they say.

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Wage Talks Recessed

Contract negotiations between General Electric Co and Westinghouse Electric Corp and the United Electrical, Radio & Machine Workers, CIO, have been recessed indefinitely. The union asked for the recess in order to report to its members. The manufacturing companies have rejected demands for a third-round wage increase.

Old-Fashioned Way Best

It was a good idea, but—

The idea was that of a foreman of the Federal Engineering & Construction Co, which is erecting a 161-kv transmission line across the Missouri River for the United Light & Railways Co.

The foreman figured that the easiest way to get a preliminary line across the 1,900-ft river span was to use a helicopter. For two days, the experiment was tried. The result was always the same. The high wind broke the line. Finally, the old-fashioned boat method was tried with success.

Straus Will Get No Pay If House Foes Have Way

An abortive effort to oust Reclamation Commissioner Michael Straus collapsed quickly last week. But the House group backing the removal attempt immediately turned to less spectacular, but perhaps more effective, sniping at Straus and other Reclamation Bureau officials.

It is no secret in Washington that the investigating subcommittee headed by Rep Forest Harness, Indiana Republican, is trying to build up an impeachment case against Straus and Richard Boke, California Regional Director for the Bureau. After examining the agency's records for weeks, the group recently opened formal hearings, with Sen Sheridan Downey, California Democrat, as the first witness.

After hearing Senator Downey, Harness suddenly requested the House Appropriations Committee to prevent the Interior Department salary payments to Straus and Boke during the fiscal year starting July 1. The latter committee was completing its consideration of the annual Interior Appropriation Bill at the time.

Harness, who said he was acting with the full support of his subcommittee, asked that a provision be written into the Interior Bill forbidding salary payments to a Reclamation commissioner or regional director of the Bureau who is not an engineer. Neither Straus nor Boke is an engineer.

Members of the Appropriations Committee refused the request. The Interior Bill, which is expected to reach the House floor this week, will contain no such restrictions on Reclamation funds, they said.

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Plan to Add 14,400,000 Kw; New Record Peak Load

Scheduled increases in installed capacity of the country's major electric utility systems for the 4-year period, 1948-1951, total 14,400,000 kw, the Federal Power Commission reports.

Peak loads on the principal systems reached a new maximum of 47,554,537 kw in Dec 1947, which was 10.1% higher than in Dec 1946 and far above the wartime maximum of 38,253,000 kw in 1945.

Annual energy requirements for 1947 totaled 251,521,919,000 kwhr. This was an increase of 31.5 billion kwhr, or 14.3% over the 220,068,692,000 kwhr in 1946. The 1947 total was substantially larger than any preceding year, topping the previous maximum of 225,103,105,000 kwhr in 1944 by 11.7%.

Utility Organized in New Mexico Plans Merger

A proposal of Frontier Power Co, a southern Colorado utility, to buy a controlling interest in the Public Service Co of New Mexico and merge the two into the Southern Rocky Mountain Power Co, has been disclosed. The incorporation in New Mexico of Southern Rocky Mountain Power has just been completed. Incorporators of the new firm are Ted Jones and Lawson K. Stiff, law partners of Albuquerque, N. Mex., and J. D. Harris, accountant.

Public Service Co of New Mexico was formed in the dissolution more than a year ago, by SEC order, of the Federal Light & Traction Co. This holding company formerly owned the four utility firms in Albuquerque, Santa Fe, Deming, and Las Cruces, N. Mex., which were consolidated into Public Service. Controlling interest of Public Service—330,629 shares out of 524,903—is now held by Cities Service Co. SEC has ordered Cities Service to sell the stock.

Jones, one of the incorporators of Southern Rocky Mountain Power, states that firm will bid upon the Public Service stock. If its bid is the successful one, the new firm plans to issue 900,000 shares of $5 common stock, and 35,000 shares of $100 preferred stock, through J. G. White Co of New York, to finance purchase of Public Service stock and to provide $4,000,000 to meet maintenance and expansion requirements during the next two years. Frontier Power Co then would be merged into the new firm. The plan contemplates also uniting the power system of the proposed merged firm—lines of Frontier Power and Public Service are now only 35 miles apart in northern New Mexico.

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City Light Gives Pay Raise

Seattle, Wash., city officials have revealed they will grant wage increases totaling $168,000 a year, retroactive to Jan 1, to City Light operating personnel outside the clerical service. The increase corresponds with that recently granted by the Puget Sound Power & Light Co. The scale of individual position wage increases will be adjusted by the Electrical Workers Union, Local 77, and the light department.

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Texas Utility Adding Unit

Central Power & Light Co has started construction of an addition to its Nueces Bay Plant in Corpus Christi. A 30,000-kw steam-driven unit will be installed to raise plant capacity to 75,000 kw.

SEC RULINGS

Carolina Power & Light Co has received commission approval to amend its charter so as to modify the present restriction upon the issuance by the company of unsecured indebtedness (10% of the aggregate of secured indebtedness, capital and surplus) by excluding the principal amount of the company's 3¼% promissory notes, due at various dates between 1952 and 1958, from the computation of the amount of such unsecured indebtedness which the company may issue without the approval of the holders of a majority of the preferred stock. The utility also plans to amend its charter so as to authorize offerings of additional common stock of the company by public offering or an offering through underwriters or investment bankers who shall have agreed to make such a public offering without first offering such stock pro rata to holders of the then outstanding common stock of the company. (Release No. 8146).

Republic Service Corp's plan of reorganization, filed by the company and Irving H. Isaac, a preferred stockholder, has been approved. The plan provides, among other things, for the organization of a new corporation with a capital structure consisting of $950,000 of debt and common stock, for the retirement of Republic's collateral trust bonds, 5%, due 1951, and for the distribution by Republic of 70,324 shares of common stock of the new corporation. The collateral trust bonds would be retired at their principal amount of $1,763,800, plus accrued interest, while the shares of the new corporation would be distributed to holders of Republic's preferred stock at the rate of four common shares for each preferred share held. Republic would then be dissolved. (Release No. 8170).

Appalachian Electric Power Co, Roanoke, Va., and the Ohio Power Co, Canton, subsidiaries of American Gas & Electric Co, will own jointly two new companies, the formation of which has been authorized by SEC. Central Operating Co, one of the new companies, is to be organized to operate a steam electric generating station which will be owned by Appalachian and Ohio. Central Coal Co, the other company, is designed to operate coal mines for the purpose of supplying, in part, the coal requirements of Ohio and Appalachian. (Release No. 8173).

Southern Utah Power Co has been authorized to issue and to sell to the Mutual Life Insurance Co of New York at a price of 100 plus accrued interest to date of delivery, an additional $250,000 principal amount of its first mortgage, Series A, 4% bonds, due May 1, 1970, to be secured by its present mortgage dated May 1, 1945 and a supplemental indenture to be dated May 1, 1948. Mutual is the holder of all of Southern Utah's presently outstanding $806,000 principal amount of Series A bonds. Proceeds of the sale are to be used to retire bank loans of $65,000 outstanding at Feb 29, 1948 and to pay for a portion of net additions to property made during 1948 in connection with the company's construction program which involves an aggregate estimated expenditure of approximately $280,000 for the year. (Release No. 8190).

New York State Electric & Gas Corp has been authorized to sell at competitive bidding $5,500,000 of 30-year first mortgage bonds and 35,000 shares of $100 par cumulative preferred stock. Company originally proposed an offering of $10,500,000 of bonds and 60,000 shares of preferred stock, but New York State Public Service Commission approved only the reduced amounts. Terms of offering are to be filed by amendment. Proceeds will be used for construction. (Release No. 8165).

Central Vermont Public Service Corp's application for exemption from competitive bidding on its proposal to sell $1,500,000 of first mortgage bonds, due on May 1, 1978, and enough common stock to yield $2,600,000 has been approved. Central Vermont is a subsidiary of New England Public Service Co. (Release No. 8174).

Kansas Gas & Electric Co got the green light for its public sale, through privately negotiated underwriting, of 250,000 shares of its common stock now held by American Power & Light Co. This sale is part of a broad plan now pending before the commission under which American Power proposes to distribute its holdings in its subsidiaries to its preferred and common stockholders. In 1942, the commission ordered American Power to dissolve. American Power plans to use the proceeds from the sale of its Kansas Gas common stock to pay for construction work of its other operating subsidiaries. In approving the sale, the commission rejected the arguments of an American Power common stockholders committee that sale of the Kansas Gas stock should not be allowed until Kansas Gas had refinanced its 7% and $6 preferred stocks and placed in commercial operation certain major generating facilities now planned or under construction. (Release No. 8181).

MEETINGS

PREVIOUSLY LISTED

Edison Electric Institute—Meter and Service Committee, Lafayette, Ind., May 24-25. Annual Convention, Hotel Traymore, Atlantic City, June 1-3.

Public Utilities Advertising Association—Annual Meeting, Hotel Cleveland, Cleveland, Ohio, May 27-28.

American Society of Refrigerating Engineers—Spring Meeting, New Ocean House, Swampscott, Mass., May 31-June 2.

Northwest Electric Light & Power Association—Personnel Section and Safety Conference, Medford Hotel, Medford, Ore., June 9-11.

Pennsylvania Electric Association—Prime Movers Committee, Hotel Casey, Scranton, June 10-11.

Arkansas Utilities Association—Annual Convention, Arlington Hotel, Hot Springs, Ark., June 14-15.

Pacific Coast Electrical Association—Annual Meeting, Fairmont Hotel, San Francisco, June 16-18.

Canadian Electrical Association—Annual Convention, Manoir Richlieu, Murray Bay, Province of Quebec, June 16-19.

American Society for Testing Materials—Annual Meeting, Book-Cadillac Hotel, Detroit, June 21-25.

American Institute of Electrical Engineers—Summer General Meeting, Palace of Fine Arts, Mexico City, Mex., June 21-25.

Expansion Program May Top $6,000,000,000 Mark

A new indication that the electric power industry's expansion program may extend well beyond five years and cost more than $6,000,000,000 came this week from President Philip Sporn of the American Gas & Electric Co.

Sporn told an AG&E annual stockholders meeting that the expansion program might extend 10 years beyond 1951. This possibility he attributed to the rearmament program, demands of the ECA program, and continuing increases in power loads.

On the AG&E system, he said, what last year was a $200,000,000 expansion program has grown to a $264,000,000 venture.

Two weeks ago, the Union Electric Co of Missouri indicated its belief that expansion of that system will extend far beyond the five years which have been assigned power expansion in this country. Executive Vice-President Ralph E. Moody told the New York financial community that, if the company's studies are correct:

"We shall have to spend at least an average of $25,000,000 annually on new facilities to meet this expansion. Specifically, $136,000,000 from 1948 through 1952, another $250,000,000 in the following decade, or $386,000,000 in all."

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Energy Production Hits New High in January

Production of energy by electric utilities during January totaled 23,958,344,000 kwhr, the Federal Power Commission has reported. This was the highest monthly production of record, exceeding Jan 1947 production by 10.7% and exceeding by 1.9% the previous high of 23,511,913,000 kwhr produced during December 1947.

Water power plants produced 6,443,980,000 kwhr in January. This was substantially below the 7,136,120,000 kwhr production of last January. Industrial production, including generation by railway and railroad plants, was 4,484,671,000 kwhr for January, an increase of 3.8% over the similar month last year. Combined utility and industrial production during January was 9.6% above the similar month last year.

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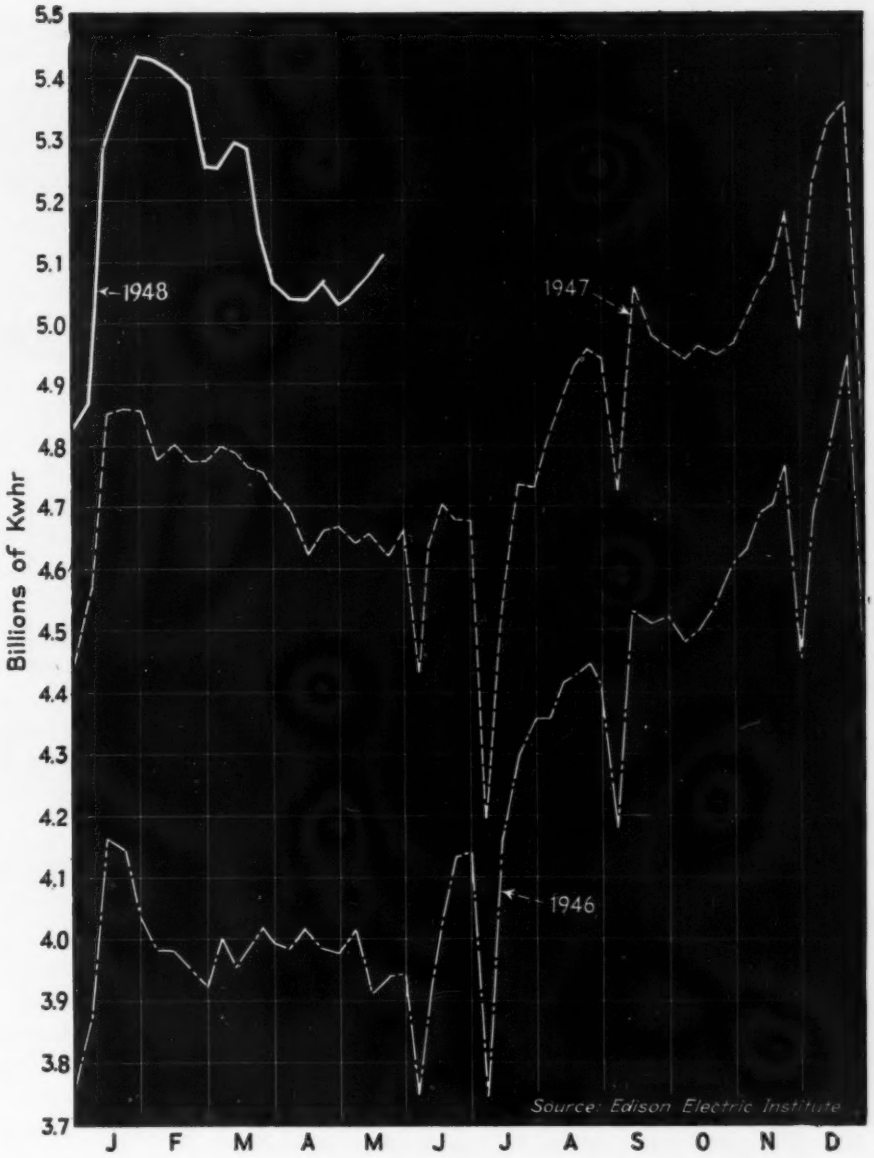
City Buy Ships for Power

Anchorage, Alaska, has purchased from the War Assets Administration for $25,000 the half of a ship which has been furnishing auxiliary power.



Woodpeckers Peck Arput into Peck of Trouble

"I'm no canary," shrieked ARPUT this week. "I won't take this sitting down," he ranted on, mixing his metaphors. "Just got tossed out of the EEI office. And whose fault was it? Those *#"$%#), chisel-mouthed, sawdust-making woodpeckers. What have they been doing? Going around pecking poles of the business-managed utilities. And it's me that gets the old heave-ho at EEI. They think I'm a woodpecker, me," he screamed, "me, the output editor of EW. Those EEI guys better not touch my pants with their feet again. I'm bellicose. And those woodpeckers, they're getting me down."

Last week, output showed the healthiest increase in months, up 10.7% over 1947.

Other News

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Weekly Output, Millions Kwhr

1948		1947		1946	
May 15	5,109	May 17	4,616	May 18	3,939
May 8	5,087	May 10	4,653	May 11	3,911
May 1	5,042	May 3	4,640	May 4	4,012
Apr. 24	5,027	Apr. 26	4,668	Apr. 27	3,977
Apr. 17	5,087	Apr. 19	4,660	Apr. 20	3,987
Apr. 10	5,033	Apr. 12	4,620	Apr. 13	4,015
Apr. 3	5,037	Apr. 5	4,693	Apr. 6	3,988
Mar. 27	5,065	Mar. 29	4,729	Mar. 30	3,992

Percent Change from Previous Year

	May 15	May 8	May 1
New England	+ 8.2	+ 5.9	+ 3.9
Mid-Atlantic	+11.1	+ 8.3	+ 6.8
Central Industrial	+11.3	+ 8.6	+ 7.5
West Central	+ 9.8	+11.2	+10.4
Southern States	+11.6	+12.7	+11.9
Rocky Mountain	+12.3	+ 9.1	+12.8
Pacific Coast	+ 8.1	+ 7.2	+ 8.0
Total United States	+10.7	+ 9.3	+ 8.7

WASHINGTON COMMENT

WILLIAM B. WHICHARD

THERE IS no longer any question as to whether public utility activities will become an issue in the 1948 election campaign. The problem now involves the seriousness of the political debate that is sure to come.

Two incidents in Washington last week afforded a preview of prospective issues. One of these events was the vote of a Senate committee to shelve proposed amendments to the Natural Gas Act. The other came during debate on an appropriations bill from which had been shorn funds sought by TVA for a steam plant.

Only major surprise in the defeat of the Moore-Rizley bill, which already had passed the House, was the 9 to 4 committee vote by which it was tabled. Every interested Capitol reporter knew in advance that a majority of the 13-man Interstate and Foreign Commerce Committee was opposed, for one reason or another, to amendment of the Gas Act as prescribed by the bill. The six Democratic senators had announced they would vote against it. But the three Republicans who voted with them—their names were not revealed by the Committee—provided the margin by which the legislation was effectively buried for at least another year, perhaps for good. And at least two of this trio must have been members of what always has been considered the ultra-conservative bloc of Senate Republicans. It's that kind of committee.

All this seems to point up earlier reports that GOP Congressional leaders had decided against enactment of any controversial utility legislation before election time. If such a policy decision actually has been made, action on proposed amendments of the Federal Power Act, or national power policy and all allied legislation certainly is unlikely this current year. Further, it would follow that some pretty savvy political minds deem such proposals as containing enough potential explosive material as to require careful thought in even a non-election year.

There is no doubt that a powerful element within the Democratic party is just as determined that public utilities, especially the electric power industry, shall be involved in the campaign. This group includes those who feel that the utilities offer a good political target just because the Roosevelt administration enjoyed good sniping at the industry's expense. That was the burden of the message FPC Commissioner Leland Olds carried to his party at Albany early last winter.

A more realistic element in the anti-utility faction seems to feel that a mere revival of the old issues may not carry enough weight. This group includes several Congressmen who fought for the steam plant and warned they would carry their fight into the coming campaign.

They inject the utility issue into this battle by attributing their reversal in the House to opposition by the electric utility industry to the TVA plant. They charge the utilities thereby succeeded in "throttling" TVA.

If the industry lets that crack go unchallenged, it will rue the day. There are too many big river basin development projects, especially in the West, about which a similar charge might be made.

TECHNICAL TRENDS

ARCHER E. KNOWLTON

Disconnect temperatures can be obtained by a new device while the switch is energized. A comparable device—perhaps like the bolometer or "snooper-scope"—would be useful to detect hot splices, clamps or connectors.

Station equipment inspections have at times disclosed conditions which almost surely would have caused trouble; e.g., deficiency of laminations in transformer, washer imbedded in a winding, loose bolts, overlooked tools, unremoved shipping braces and tags.

Precipitators, fans, air-preheaters, etc, are being put on the roof to cut down cubic feet of building volume.

Construction costs are so high as to necessitate crowding some new boilers and generators into the small space vacated by smaller, obsolete units. Shoehorn fits are not conducive to facile operation and maintenance.

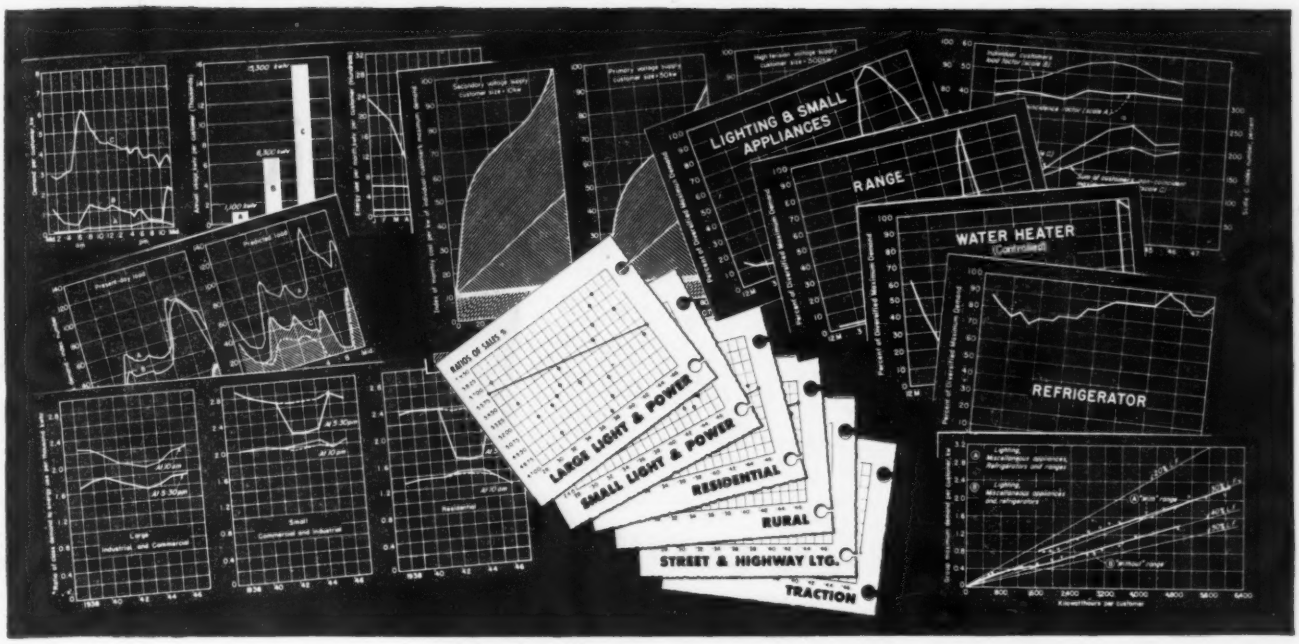
Auxiliary system reliability with pulverized coal must be adequate to avert furnace explosions if the flow to the burners is interrupted. One study showed a 20-second limit.

Hydrogen pressures may go up. Not all the alternators designed for 15 psi have been operated at that pressure but the gain potentially available naturally prompts the thinking about even higher pressures. There is not much justifying information, however.

Paralleling experience has been so poor with some companies that transfer of auxiliaries is regularly done dead. Others parallel without misadventure. The reasons are somewhat hidden.

Auxiliary cubicles should not be exposed to boiler wall or main pipe temperatures. Why let extraneous heat limit the thermal capacity? It has happened.

Diesel-driven exciters could conceivably supplant station batteries but one obstacle would be the operators. Some want no such transition in practice.



Load Analysis Is Necessary To Meet Tomorrow's Requirements

Not safe just to let loads grow and hope they will be compensatory. To assure investment return, loads must be built in full knowledge of their characteristics

THE NEED OF THE TIMES is for completely informed policy and action in every phase of the electric utility business. Nothing less will do if the industry is to be held as a field for private enterprise. The first function of the utilities is to supply electric service to the people. That function must be so discharged as to protect capital already invested in the industry and to attract new capital to it. If this is not done, the government must, and it will, take over.

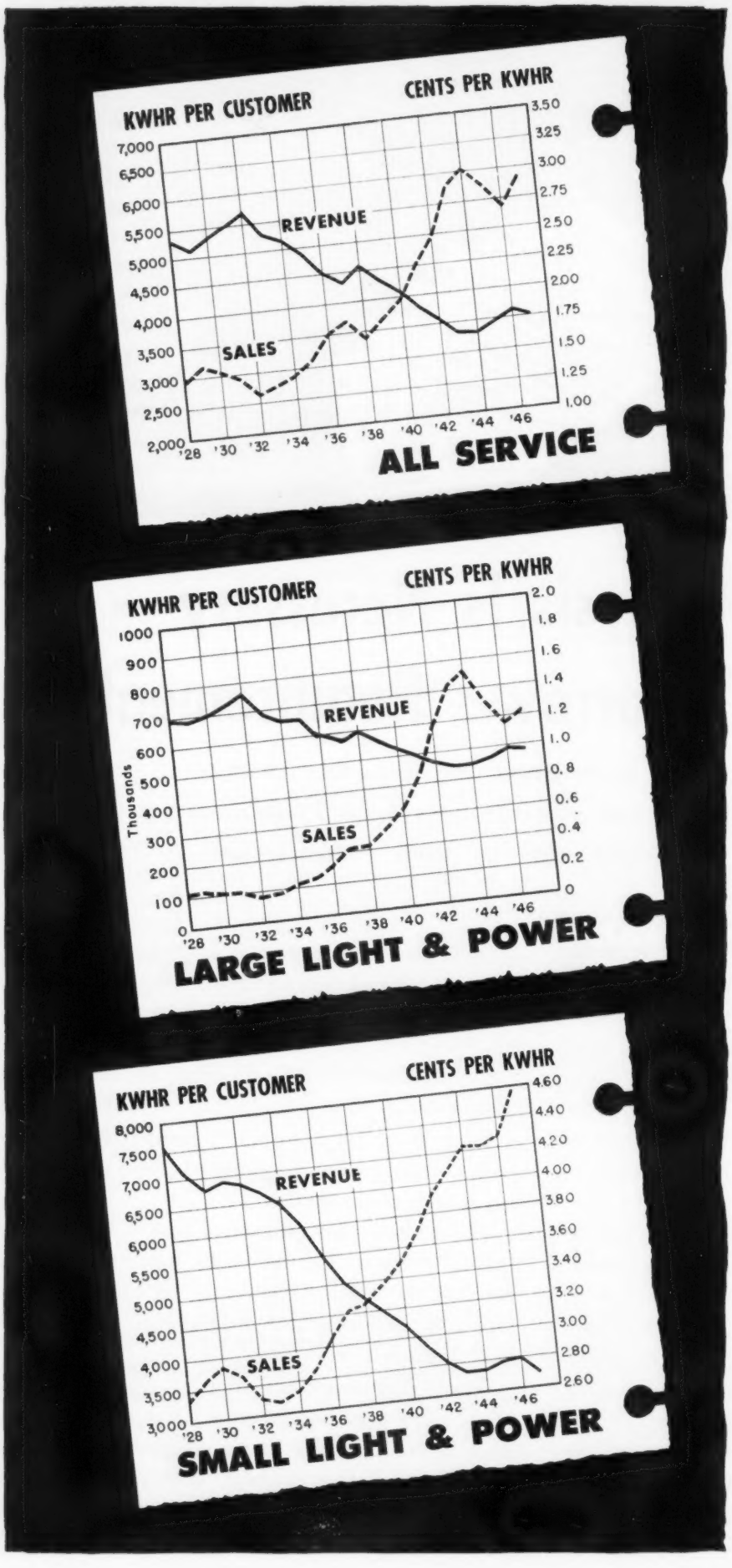
Utilities exist by the loads they serve. To assure adequate return on the rapidly enlarging investment in them, utilities must have compensatory loads. Such loads will not just grow. They will have to be built. Like stones in a cathedral, their components will have to be sized and shaped to fit into a planned structure.

Without sufficient knowledge, this can not be done. In general, utilities do not have sufficient knowledge of their loads, of the trends and characteristics of them. In the following pages, Electrical World indicates what that knowledge should include and how it can be obtained.

Since future load must be built on that existing, attention is directed first to the load trends as they appear in the statistical record. Here, by customer classes and over a 20-year period, are shown sales and revenues in unit terms and as proportions in annual totals. Here, also, is a comparison of customer and population growths for the nation and the nine census regions.

Future load possibilities, such as in house heating, air conditioning, industrial heat applications, are discussed. The intention is not to present detailed or comprehensive information, but to suggest potentialities.

These discussions of trends and possibilities lead up to the major purpose of the editorial effort. This is to emphasize the importance of load research, to tell how to do it, what data to obtain from it, and how to use the data to predict and to shape the make-up of future loads.



Unit Sales UP . . . . .

REVENUE of 2.66 cents per kwhr national average for all service, was collected by utilities in 1928. Twenty years later the average had dropped to 1.77 cents, down a third. In the same time the national average annual sale per customer about doubled, from 2,970 to 5,835 kwhr. The decline in unit revenue resulted partly from rate reductions and partly from rate forms by which unit price goes down automatically as energy usage increases.

Importance of the rate form as a determinant of unit cost of electricity to the user is beautifully indicated by the shapes of the curves in the all service graph (upper left). Up to 1940, the curves are closely symmetrical, almost mirror reflections of each other. When energy usage goes up, unit revenue goes down in nearly perfect matching. Although the rises and declines coincide in time after 1940, they do not correspond in size so closely as before. The shapes after 1940 indicate that increasing usage was hitting the lowest rate steps and thus was having less effect on the unit price.

Highest average usage and lowest unit revenue are in supply to large light and power customers (center left). While revenue per kwhr decreased about a third, from 1.4 to 0.97 cents, kwhr per customer was multiplied nearly 6 times, from 115,300 to 620,000. There is little symmetry between

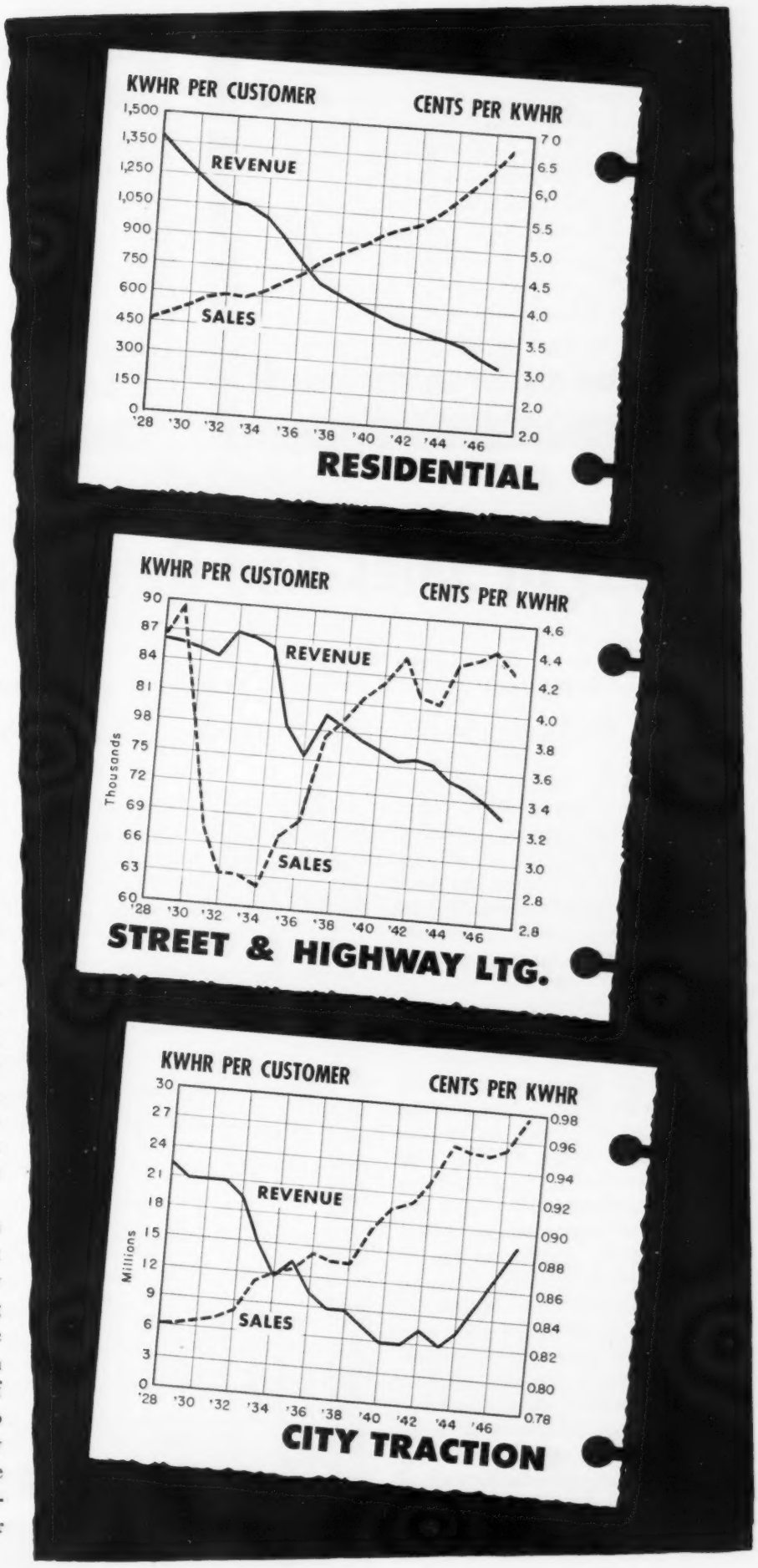
Unit Revenue DOWN

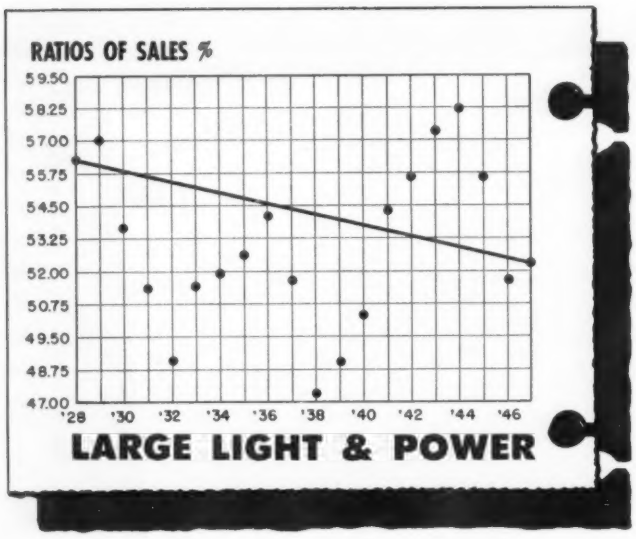
the curves of this graph. Here appears the effect of competition which in general has always held industrial rates to lowest possible levels.

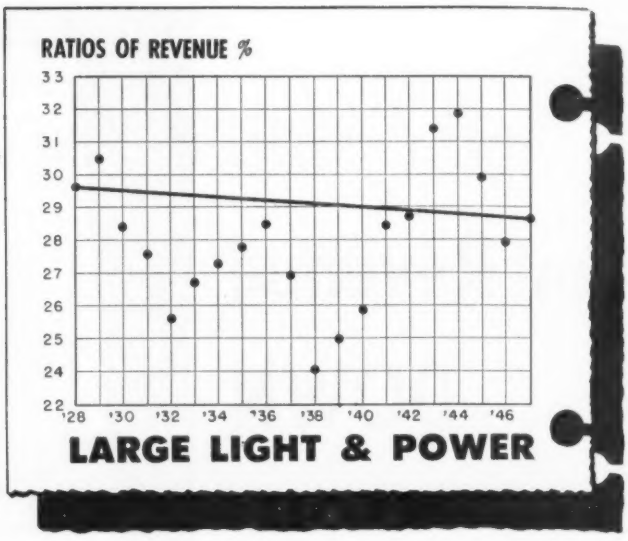
In the 20-year period average energy usage by small light and power customers (lower left) more than doubled, from 3,397 to 7,949 kwhr. Unit revenue dropped about 40%, from 4.45 cents to 2.69. The period trends of revenue and sales in this customer class correspond more closely to the averages for all service than do those of any other.

Largest decrease in unit revenue, a decline of over half, from 6.63 to 3.09 cents, occurred in residential service (upper right). In the same time average energy usage per customer more than tripled from 463 to 1,438 kwhr. A notable thing about this class of service is the absence from it of abrupt changes. The curves of revenue and sales are smoother and approach straight lines more closely than any of the others.

The remaining two graphs (center and lower right) of street and highway lighting and of city traction services, are interesting because their curves are so erratic in comparison with the others. In the former can be seen the wave of municipal economy that caused so many darkened streets in the early thirties. In the latter appears the revival of electricity in city traction that started during the war and still continues.





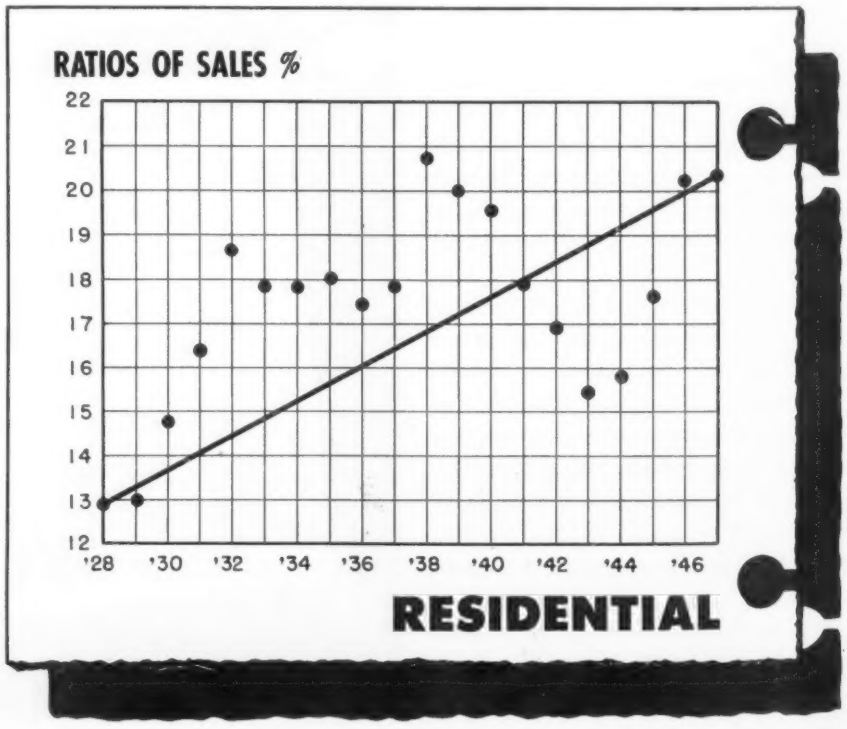


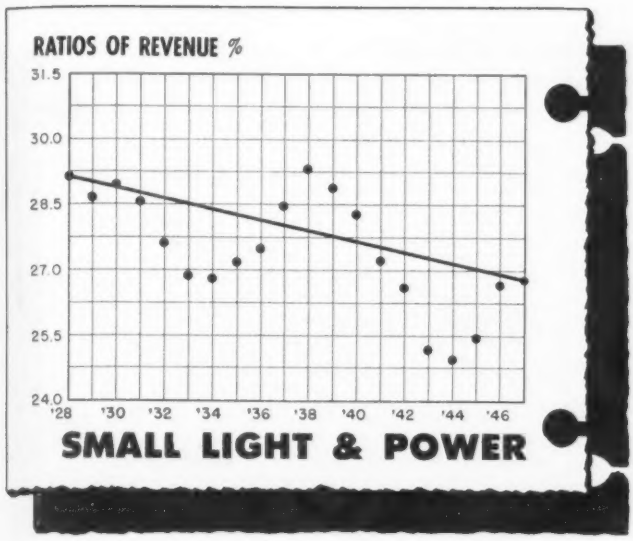
Trends In Sales And Revenue Proportions

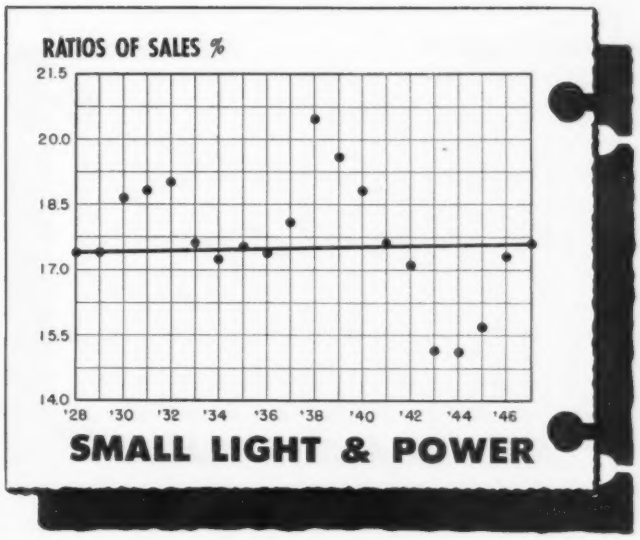
Changes in annual ratios of customer class sales and revenues to totals suggest directions to be taken in rate and load developments

OVER the long run—20 years, 1928-1947—changes in the relative proportions of different classes of service in total sales and revenues of electric utilities have been small. But these small changes are significant. The largest of them were in residential service, up 7.43% in sales and 3.3% in revenue. Much of the increase in the proportion of residential sales was at the expense of large light and power service, its sales proportion down 4%. But the reduction of the latter in revenue proportion was only 0.97%. This small decrease in the proportion of revenue, accompanied by a decrease in sales proportion over 4 times as great, is evidence of the general good fit of large light and power rate schedules to service requirements. These ratios may also be evidence of the merit of competition as a factor in rate making, as it generally is in this customer class.

The increases in residential sales and revenue proportions are much more significant than the figures of them indicate. The 7.43% increase was from 12.89 to 20.32%. This says that in sales proportion residential service in 1947 is 60% more important than in 1928. The 3.30% rise was from 32.10 to 35.40%, which is to say that in revenue residential service was only about 10% more significant in 1947 than in 1928. Here is disclosed the fundamental argument for informed and aggressive activity in development of residential service. The fact of

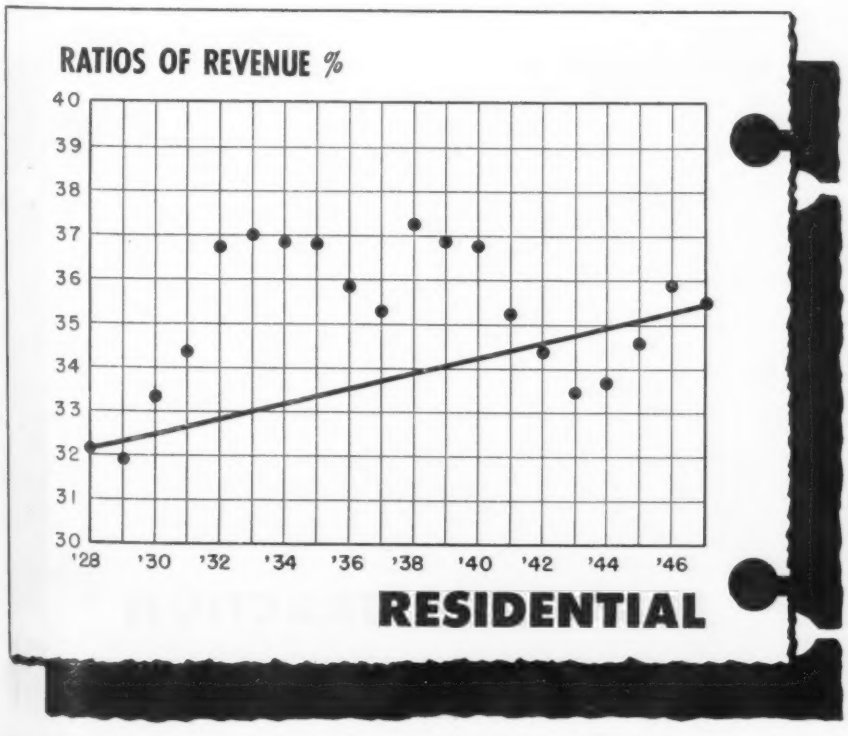






Ratios Of Class Sales And Revenue In Totals

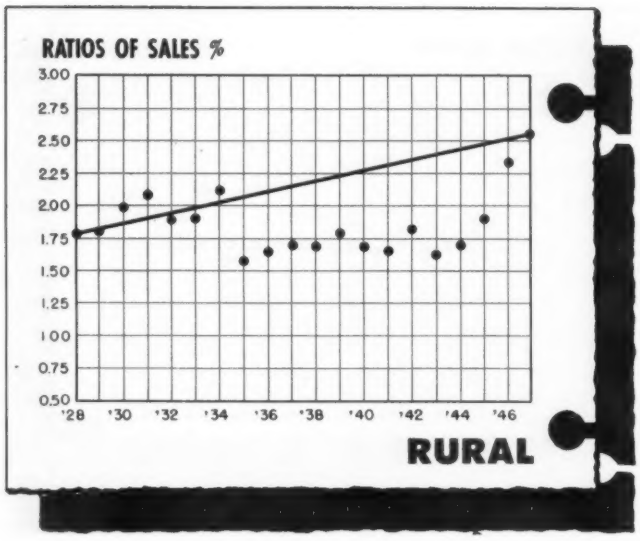
	1928 %		1947 %		Change to 1947 %	
	Sales	Revenue	Sales	Revenue	Sales	Revenue
Large Light & Power	56.20	29.62	52.20	28.65	−4.00	−0.97
Small Light & Power	17.41	29.10	17.62	26.75	+0.21	−2.35
Residential	12.89	32.10	20.32	35.40	+7.43	+3.30
Rural	1.77	1.17	2.55	3.19	+0.78	+2.02
Street & Highway Lighting	2.85	4.65	1.09	2.02	−1.76	−2.63
Traction	8.28	2.92	3.26	1.63	−5.02	−1.29
Other Service	0.60	0.44	2.96	2.36	+2.36	+1.92

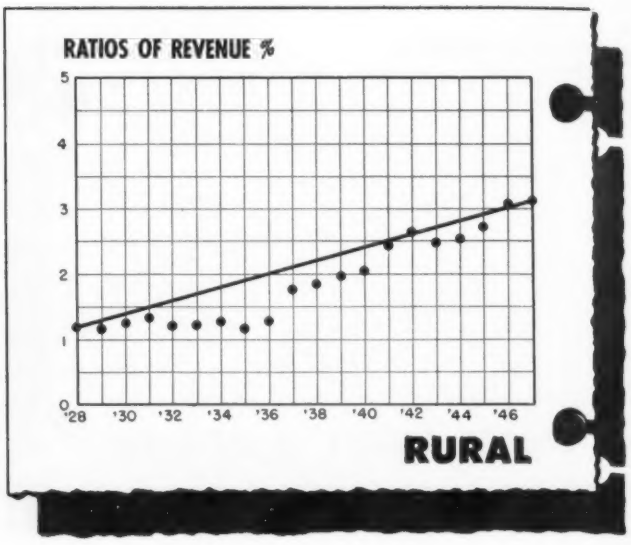


sales proportion rising 6 times as fast as revenue proportion is a challenge to utility management, a double-barrelled challenge to perspicacity in rate-making and to intelligence in load building.

The graphs show apparently wide variations in the proportions of large light and power sales and revenue during the 20 years. But in respect to sales, the range of variation is only 11%, from 47.20 in 1938 to 58.20 in 1944. As to revenue, the range is 7.80%, between 24.05 and 31.85 for the same years. Considering that the period included a severe depression and a war, the ranges of variation are much less than might have been expected. In view of the year-to-year variations shown on the graphs, it may seem that the trend lines connecting terminal points are misleading. If the lines had been drawn with a planimeter to put equal areas of the curves above and below them, their slopes would have been more sharply downward. Possibly this would show a truer picture. Either way, the trends of sales and revenue proportions of this class of service are downward. It is to be noted that it took a war to lift these proportions above their levels at the beginning of the 20 years.

Small light and power service differs from its large brother in that trend of sales proportion is slightly upward, 17.41% in 1928 and 17.62 in 1947. But in respect to revenue, the trend of small light and power is also downward. Here, again, the ranges of variation from year to year





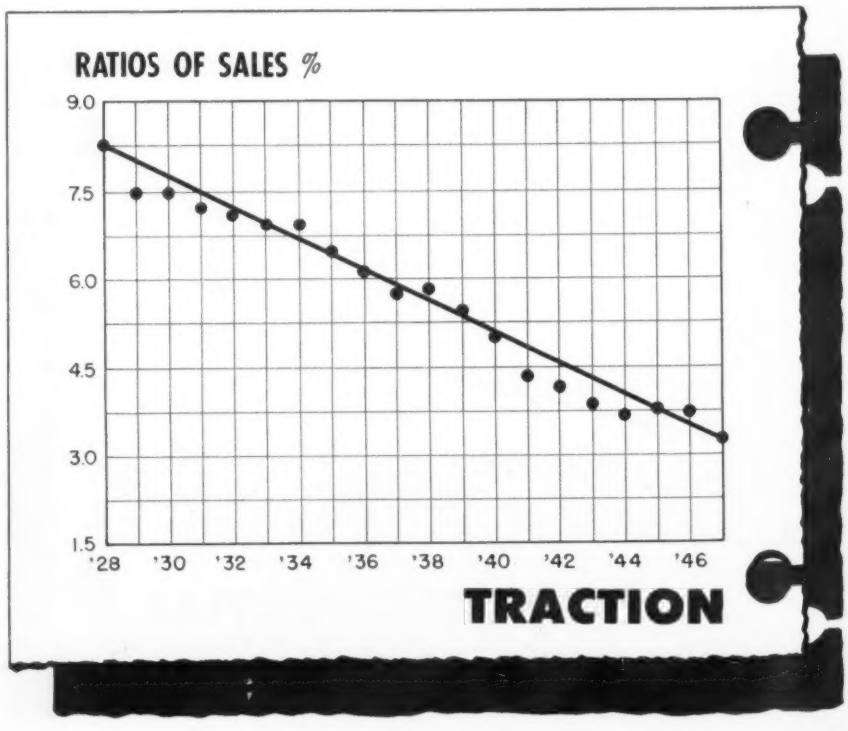
appear quite large on the graphs, but actually are not. The range for sales is only 5.34%, from 20.44 in 1938 down to 15.10 in 1944. For revenue, the range is even less, 4.37%, down from 29.32 in 1938 to 24.95 in 1944. It may not be assumed that proportions of customer class sales and revenues in totals should remain constant through the years as the industry grows. Differences in costs of service to the different classes prevent such an assumption. But it is not unreasonable to argue that if in any class the trend of sales proportion is up and of revenue is down, then perhaps some thought should be given to the condition. This seems to be the case with small light and power service.

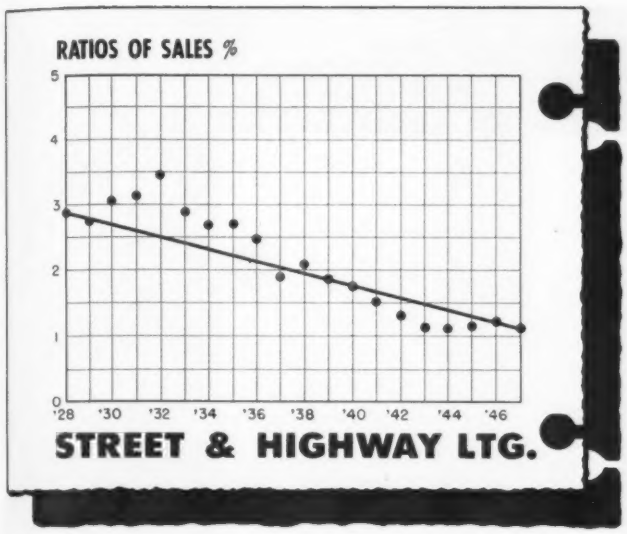
Sales And Revenue Stability

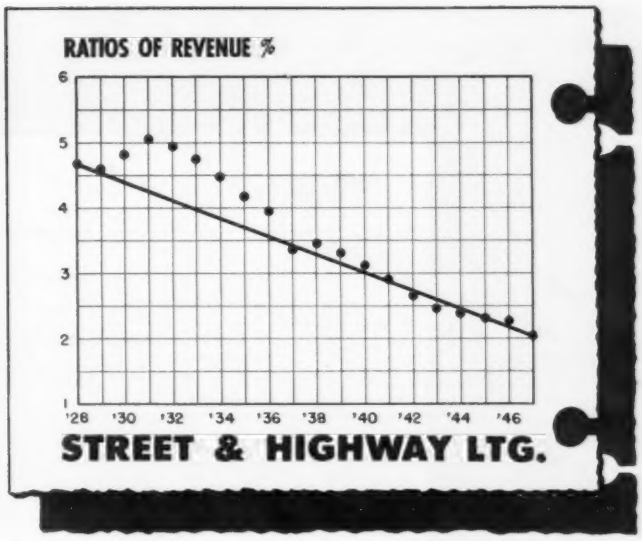
Highest points in residential service for proportions of sales, 20.68%, and of revenue, 37.21%, were in 1938. Lowest points were, sales, 12.89% in 1928, and revenue, 31.90% in 1929. The range of variation in the one case is 8.79% and in the other, 5.31%. These ranges, narrower than those of large light and power service, are wider than of small light and power. This would seem to controvert the general idea of greater stability of sales and revenue of residential service. Whether it does or not is a matter for more detailed analysis than can be indulged in here. At any rate, it indicates the desirability of more knowledge of the characteristics of the small light and power load to see if greater attention should be given to its development.

Rural service, like residential, shows increases in both sales and revenue proportions over the 20 years. This likeness was to be expected, since the two services are not greatly different in their load characteristics. The time may come when farm customers will have so much increased their uses of electricity as to give this class of service a distinct individuality of its own. But for the present rural service must be regarded as about the same as residential so far as general load characteristics are concerned. Many utilities have this viewpoint, as they serve rural customers on urban rate schedules. Because of this overlapping of the two classes, the graphs of rural service sales and revenue proportions reflect changes over the 20 years only hazily. It is perhaps significant to note how closely the yearly revenue ratios are to the trend line.

In view of the promotional pressure now being put on this service, the graphs of street and highway lighting have significance greater than the ratios on them indicate. Certainly they show that the promotion is needed if the service of lighting our streets and roads is to be restored to its former proportions in utility sales and revenue. In the 20







years the proportion of this service class in sales declined from 2.85% to 1.09, and in revenue from 4.65% to 2.02. In both aspects, it was less than half as important in 1947 as in 1928.

With traction service, the case is similar, a steady decline in sales and revenue significance. The graphs show sales proportion down from 8.28% in 1928 to 3.26 in 1947 while revenue proportion dropped from 2.92 to 1.63%. It is notable in both graphs how closely the yearly points hug the trend lines. Possibly the modern trolley bus and the reawakening of interest in railroad electrification may cause a change in these sales and revenue trends of the past 20 years.

This discussion has dealt exclusively with the relative contributions made by classes of customers to annual sales and revenue totals. These proportions are important because close correspondence between them and their parallels in other aspects of system design and operation is essential to successful utility management. In any utility, knowledge of these proportions and of their past and indicated future trends for the particular case should be most helpful in system planning, in rate making and in load development.

The percentage figures of this article are used as if they were exact. They had to be so regarded for graphs to be made with them and to avoid the prolixity of continual qualification in the discussion of them.

Only General Conclusions

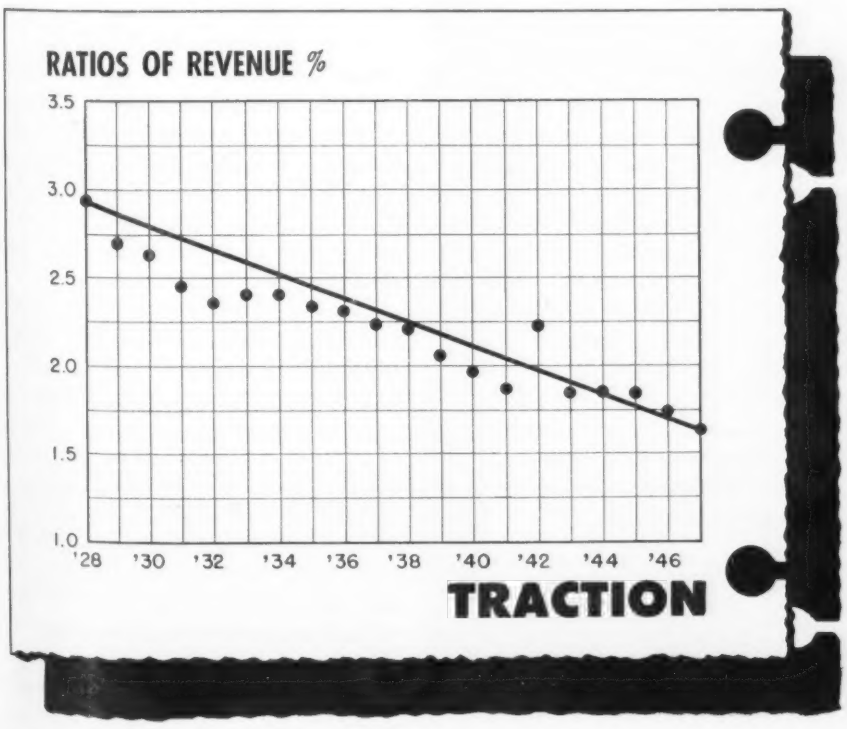
Actually the figures are approximations, the best obtainable from available statistics but not so accurate as their statement to two decimal places makes them appear. The several statistical series from which the proportions were calculated are not entirely reliable. A general reclassification of customer accounts occurred, 1936-1937, and other adjustments have been made in the different series from time to time. But these statistical deficiencies do not prevent the drawing of some general conclusions. They include:

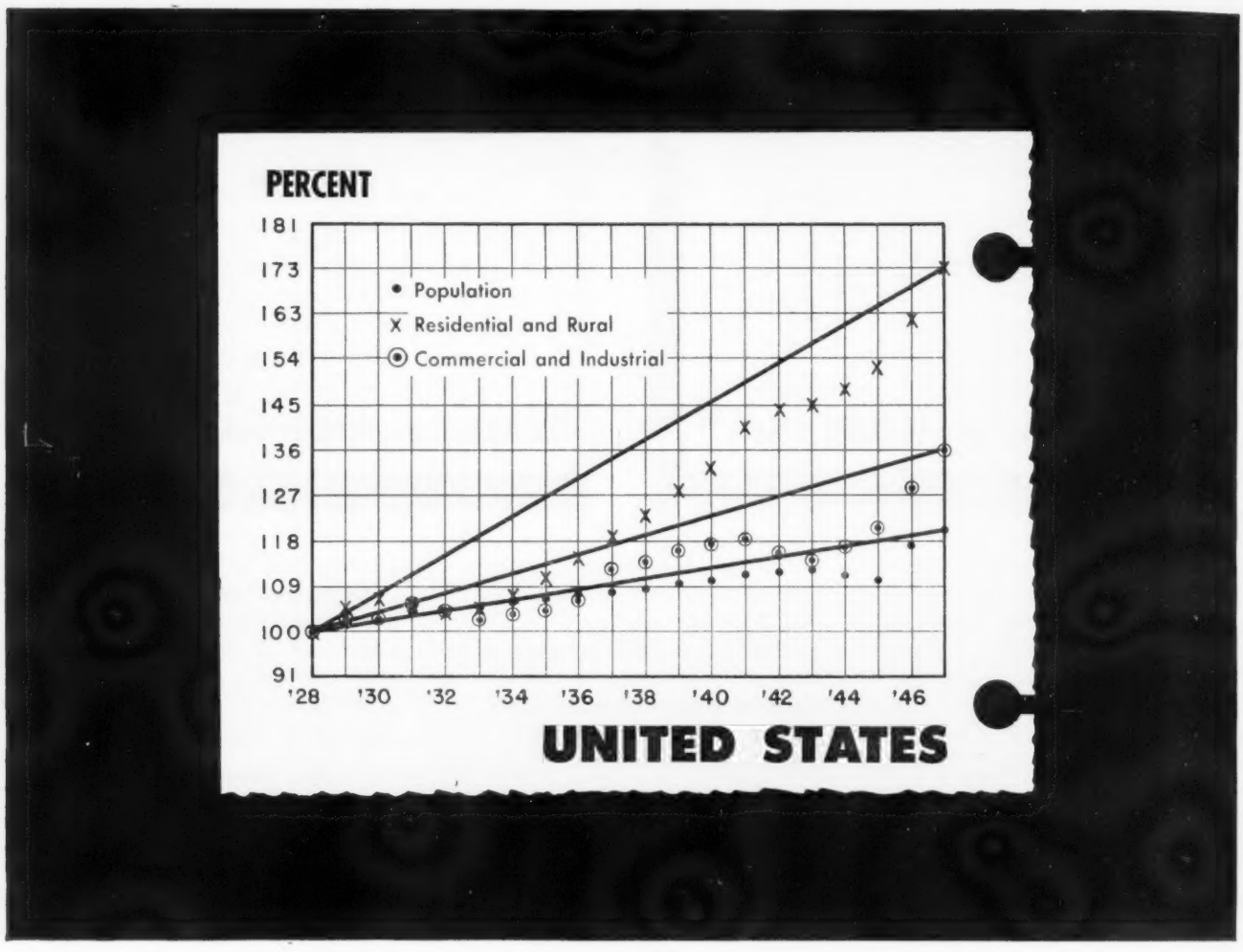
1—Revenue from residential service is probably not rising fast enough in comparison with energy sales.

2—A similar condition exists in small light and power service. The revenue proportion is declining while the sales proportion remains fairly constant.

3—In large light and power service, more than in any other, rate schedules are effective in shielding revenue from sales decreases.

4—More effort is needed if the declines in proportions of street and highway lighting and of traction service are to be checked.





Customers Vs Population

NOT YET has growth in number of electric utility customers reached equilibrium with population increase. The graph above shows that for the whole country customers are still being added faster than population rises. Graphs on following pages show this is true also for each of the 9 Census regions.

In 1940 there were 34.9 million occupied dwelling units in the country and 25.6 million residential and rural customers. Assuming that occupied dwellings are the limit to number of these customers, the utilities had 9.3 million to go in that year. In 1946, occupied dwelling units are estimated at 35.9 million and residential and rural customers were 30.4 million. The gap had narrowed to 5.5 million. Actually, the number of customers is closer to the limit than the figures indicate. Singly, not all dwelling units are customers. Some of them are in multiples as customers, such as in housing projects or apartments served through single meters.

If the present rate of new customer connections continues, it will not be long before the ratio of customers to population reaches stability.

All of the graphs of this series are of indexes with 1928 as the base year. The yearly indexes are shown simply as points, the lines to join them into curves being omitted so that the more significant trend lines drawn between terminal points would stand out more clearly. Terminal values for the U. S. graph above are:

	1928 (1,000)	*1947* (1,000)	*% of 1928*
Pop.	119,862	143,382	119.7
R & R	19,255	33,144	172.0
C & I	3,868	5,258	136.0

Residential and rural (farms included) customers are combined because together they represent the domestic use of electricity. Figures of commercial and industrial customers used for these graphs represent service to the business community. Thus the graphs show the two principal aspects of electric service, in the home and in business.

In the 20-year period, U. S. population increased about 20%. Residential and rural customers rose 72% and commercial and industrial 36%.

In the regional graphs the record of shifting in population and industry in the past two decades appears plainly, as does also the acceleration of it caused by the war. Particularly outstanding is the movement of people and of industry to the Pacific region, its proportionate increases in all three of the plotted quantities considerably higher than for the nation.

NEW ENGLAND region includes Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut

Terminal Values of Graph

	1928 (1,000)	*1947* (1,000)	*% of 1928*
Pop.	8,036	9,327	116.1
R & R	1,742	2,466	141.6
C & I	371	374	100.5

For 16 consecutive years after 1930, numbers of commercial and industrial customers remained below the figure of 1928. Possibly the recovery of this group from the low point of 1943 indicates that the flight of business and industry from New England has been checked.

MIDDLE ATLANTIC region includes New York, New Jersey, Pennsylvania

Terminal Values of Graph

	1928 (1,000)	*1947* (1,000)	*% of 1928*
Pop.	25,578	28,809	112.6
R & R	5,427	7,483	137.7
C & I	1,032	1,253	121.3

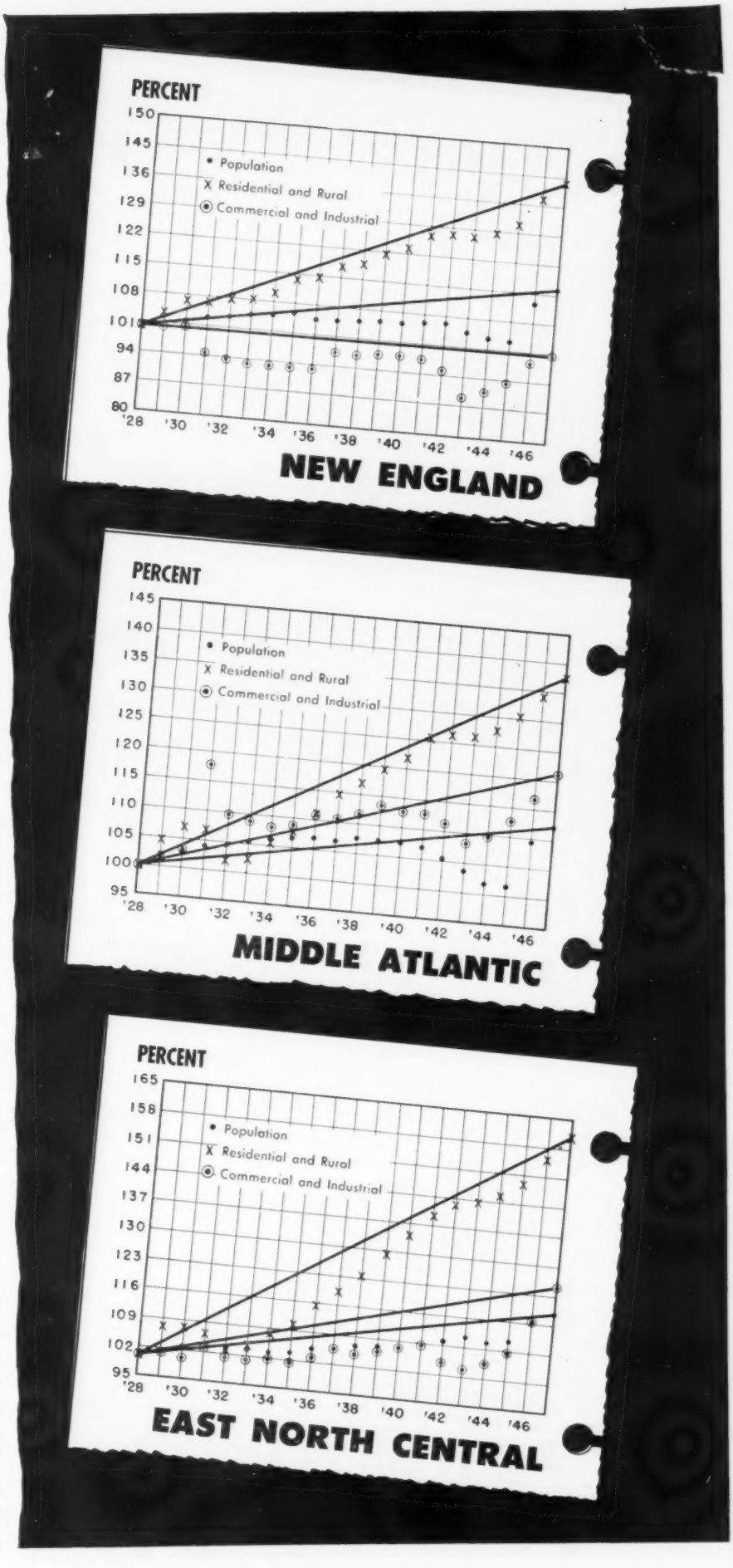
In 1928, the index base year, this was the most populous region of the nation. Now it is second in population rank. This decline shows in the rates of growth of utility customers, both of them less than for any other region.

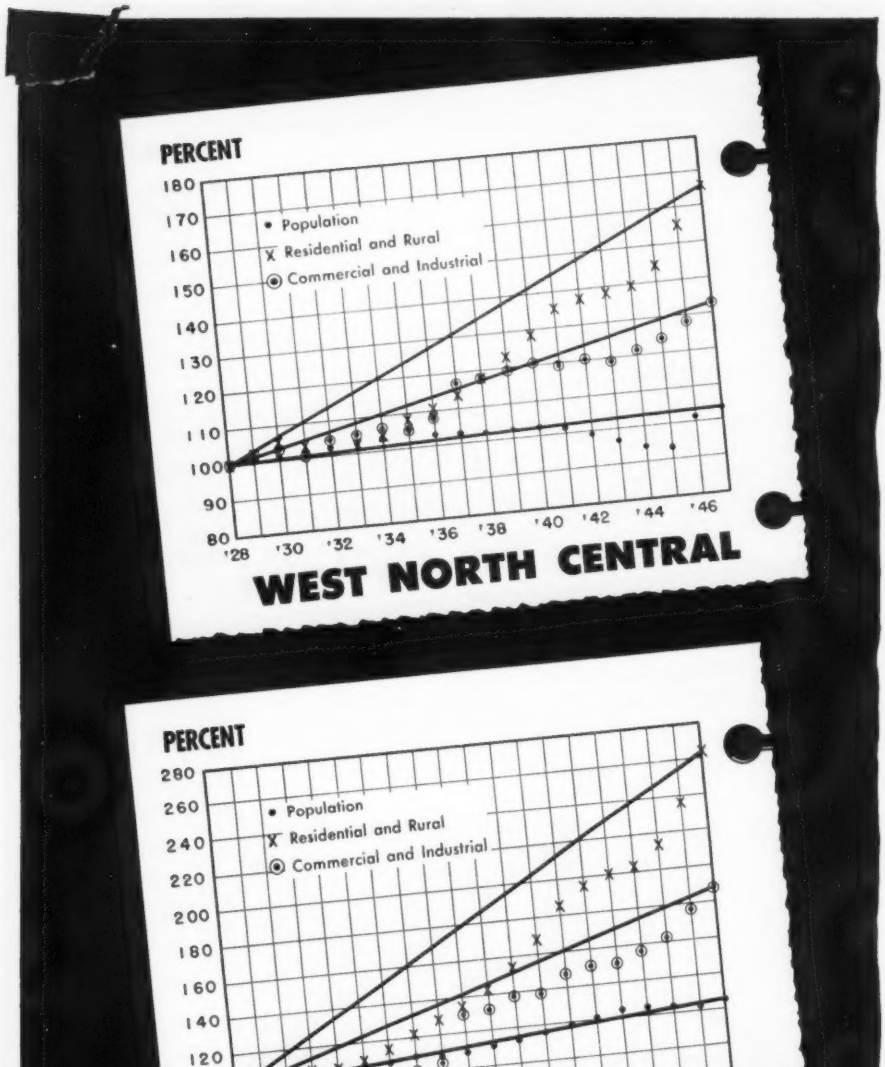
EAST NORTH CENTRAL region includes Ohio, Indiana, Michigan, Wisconsin

Terminal Values of Graph

	1928 (1,000)	*1947* (1,000)	*% of 1928*
Pop.	24,645	29,382	119.0
R & R	4,631	7,460	160.9
C & I	849	1,064	125.3

The 19% rate of population increase in this region is very close to that of the nation, but the rates of customer increases are slower. The fact that increase in commercial and industrial customers both numerically and percentage-wise, in this region is so close to that of the next most populous region, the Middle Atlantic, indicates that these customers are perhaps closer





to equilibrium with population in these two regions than in most other parts of the country.

WEST NORTH CENTRAL region includes Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas

Terminal Values of Graph

	1928 (1,000)	*1947* (1,000)	*% of 1928*
Pop.	13,168	13,688	103.8
R & R	1,867	3,090	165.4
C & I	398	533	132.9

These are prairie states, large in area, thin in population. And population increased only a little in the 20 years. Yet increases in numbers of customers of both groups were not much less in proportion than for the whole country. Effect of war on customer growth was less in this region than in any other.

SOUTH ATLANTIC region includes Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida

Terminal Values of Graph

	1928 (1,000)	*1947* (1,000)	*% of 1928*
Pop.	15,486	19,499	125.9
R & R	1,386	3,663	264.0
C & I	301	568	188.5

In this region population increased faster than in any other, except the Pacific. That customers increased so much faster than population is evidence of a lower than average customer-population ratio at the start of the 20-year period.

EAST SOUTH CENTRAL region includes Kentucky, Tennessee, Alabama, Mississippi

Terminal Values of Graph

	1928 (1,000)	*1947* (1,000)	*% of 1928*
Pop.	9,718	10,771	110.8
R & R	621	1,763	283.8
C & I	159	243	152.8

These might be termed the TVA area states. Speed of population growth was slower in only one other region. But here occurred the fastest regional growth in residential and rural customers. Four

other regions had faster increase in commercial and industrial customers.

WEST SOUTH CENTRAL region includes Arkansas, Louisiana, Oklahoma, Texas

Terminal Values of Graph

	1928 (1,000)	*1947* (1,000)	*% of 1928*
Pop.	11,847	13,881	117.1
R & R	980	2,597	265.0
C & I	263	428	162.6

Exceptionally rapid growth in residential and rural customers in relation to less than average population increase appears again in this region. And again this is a matter of arithmetic—higher percentages resulting from smaller starting figures.

MOUNTAIN region includes Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada

Terminal Values of Graph

	1928 (1,000)	*1947* (1,000)	*% of 1928*
Pop.	3,639	4,399	118.1
R & R	520	1,030	198.0
C & I	110	172	156.3

This sparsely settled region is another with less than average rate of population increase and with more than average growth in utility customers.

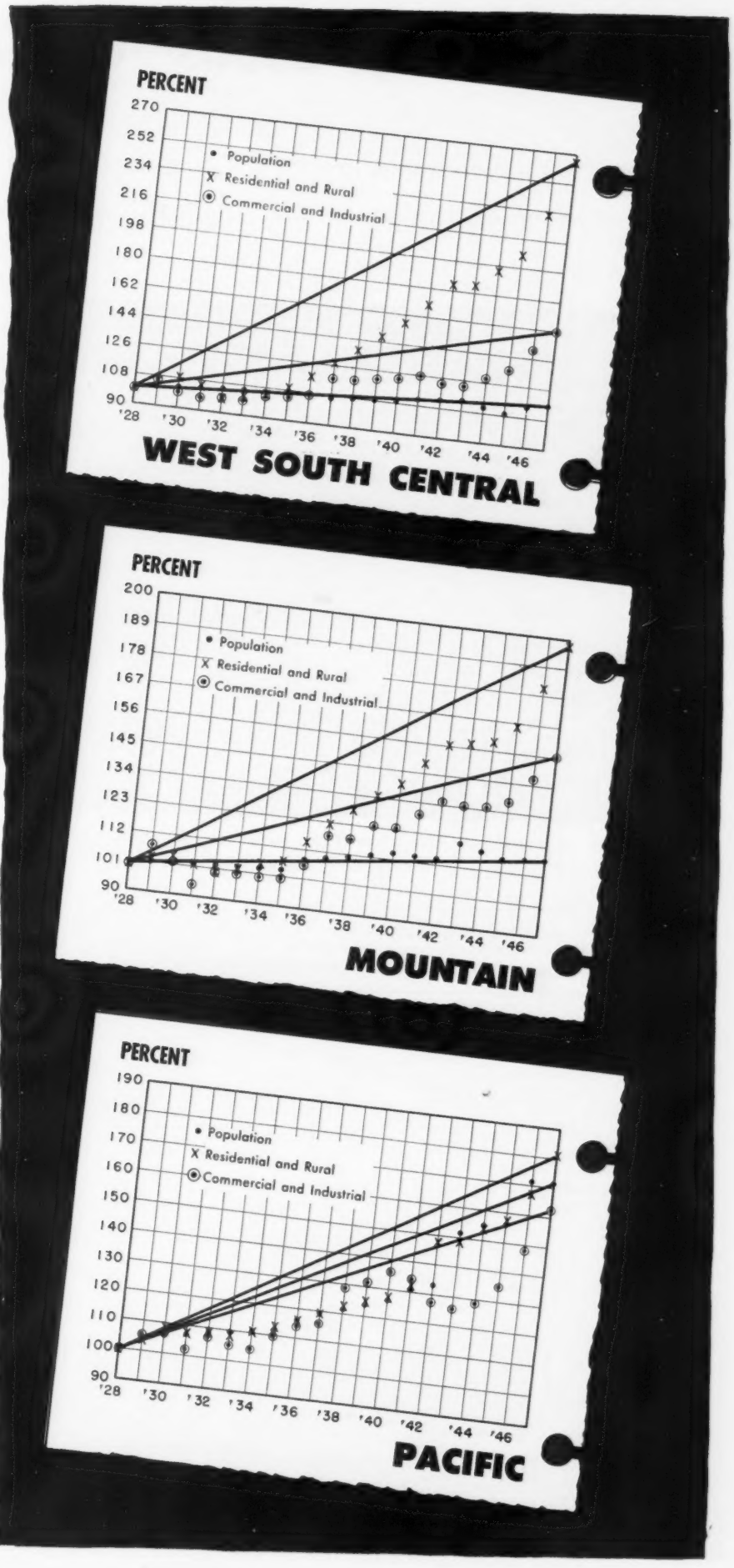
Probably much of the customer increase resulted from extension of rural electrification, accelerated by more land irrigation.

PACIFIC region includes Washington, Oregon, California

Terminal Values of Graph

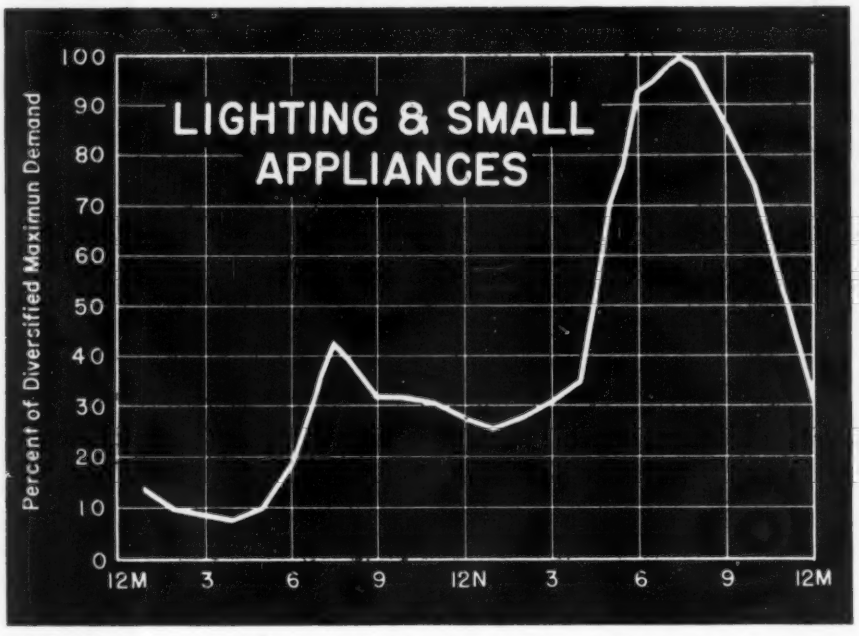
	1928 (1,000)	*1947* (1,000)	*% of 1928*
Pop.	7,746	13,265	171.2
R & R	1,983	3,592	181.0
C & I	385	625	162.2

Of all the regions, this is the only one in which the 20-year rates of increase in population and in all utility customers approach equality. This is shown by the closeness of the trend lines in the graph. The war did much to cause this condition.



Residential Loads—Old And New

Non-coincident and diversified demands and energy consumptions of domestic appliances and applications—Future load possibilities



LIGHTING and small appliance load—characteristic winter weekday curve shape

TABLE I—Load Characteristics Of Domestic Appliances And Uses In Urban Communities In Middle Eastern Section Of United States (30-Minute Integrated Demands)

Appliance or Application	Annual Energy Use Kwhr	Non-coincident Maximum Demand Watts	Diversified Maximum Demand Watts*	Diversity Factor	Coincidence Factor %
Blanket	150	225	130	1.73	57.8
Blower (Heating)	250	250	100	2.5	40.0
Clock	15				
Clothes Drier	150	4,500	350	12.86	7.8
Coffee maker	72				
Dishwasher	48	330	67	4.93	20.3
Disposal Unit	30				
Electrostatic Precipitator	300	35	35	1	100.0
Fan (Attic)	150	330	155	2.23	47.0
Fan (Ventilating)	20				
Flatiron	100				
Germicidal Lamp	200	23	23	1.0	100.0
Home Freezer	600	300	75	4.0	25.0
Ironer	100	1,550	50	31.0	3.2
Lighting (Average)	256				
Misc. Appliances	90				
Oil Burner	250	250	100	2.5	40.0
Radiant Heater	45				
Radio (Console)	100				
Radio (Portable)	50				
Range (in city)	1,200	3,600	760	4.74	21.1
Refrigerator	347	180	45	4	25.0
Roaster	300				
Room Cooler	150	430	300	1.43	69.7
Stoker	250	250	100	2.5	40.0
Television	150				
Toaster	25				
Waffle Iron	12				
Washing Machine (Automatic)	50	330	50	6.6	15.1
Washing Machine (Non-automatic)	24				
Water Heater (Controlled)	3,500	1,580	1,425	1.11	95.2
Water Heater (Uncontrolled)	3,500	1,500	730	2.06	48.7
Workshop	150				

* Based on average winter weekday maximum demands.

INDIVIDUAL APPLICATIONS are the building blocks that compose electric system loads. In all load problems—engineering, rate, sales or any other—the loads of these individual applications are the primary elements. The more that is known about them the more desirable over-all load can be built with them.

At the end of 1947, there were between 6 and 7 residential customers (including rural and farm) to every one in all other classes together. Customers in this group (86% of the total) bought only 23% of the electricity sold in the year, but from them came 39% of the revenue. Their preponderant majority in the total number makes residential customers and their load characteristics a matter of vital concern to utility management. And whether a utility does or does not promote residential uses of electricity makes no difference; its load and energy sales in that customer class will increase.

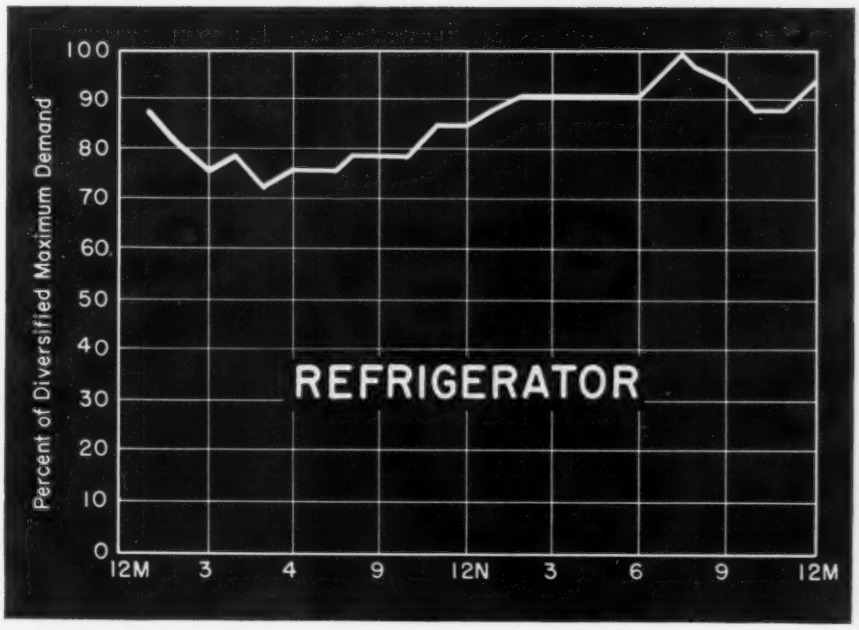
Local Data Needed

Illustrative of information required for knowledge of residential load characteristics are the data in the accompanying tables. For any particular utility the figures maybe quite different from those in the tables. Thus it is best to determine load characteristics of applications and of customer groups by local research. Next best is to find applicable data in reports of researches made in conditions of climate, living habits, economic levels etc, as nearly like the local scene as possible.

Table I and related graphs were derived from researches in the middle eastern part of the United States. They show average characteristics of a large number of appliances and indicate typical shapes of daily load curves of a few. Just as the data of them may not be valid in other parts of the country, so also may their

characteristics change with the passage of time.

Light sources are frequently cited as an example of the improved efficiency of electricity applications over the years. Since the first electric lamp, light production efficiency has increased about 30 fold, while energy consumption per unit of light is down about 97%. This is a spectacular example, but not by any means the only one. When first introduced the average electric refrigerator used up to 1,000 kwhr per year; now it uses only about 350. Electric ranges now have about one fifth higher wattage ratings than they did 20 years ago. Yet by combination of better efficiency and changes in cooking habits they use about 30 percent less electricity while cooking faster and more satisfactorily. All along the line this story of improvement is repeated. As it continues, load characteristics change, adding strength to the reasons for continuous load research.



REFRIGERATOR LOAD—characteristic winter weekday curve shape

Loads Of The Future

Water heating and space heating appear as loads of rapidly growing importance. Water heater sales since the war have been phenomenal. According to M. M. Feaman (EW, Mar 27, 1948 p 96) they are selling now 5 times as fast as pre-war. Part of the reason for this is the popularity of the automatic clothes washer. But, mostly, the answer is simply that more people are using hot water more freely and have learned that electric heat is the most convenient and a not too expensive way to obtain it. As water heater load increases, the question of controlled or uncontrolled service becomes more important. Off-peak service improves residential load factor and thus keeps down system investment, although the cost of control equipment and of maintaining it must be considered. And as the number of heaters connected grows larger, it is possible to foresee a time when this off-peak load may establish a peak by itself. This illustrates how a sales policy can be derived from or changed by load research.

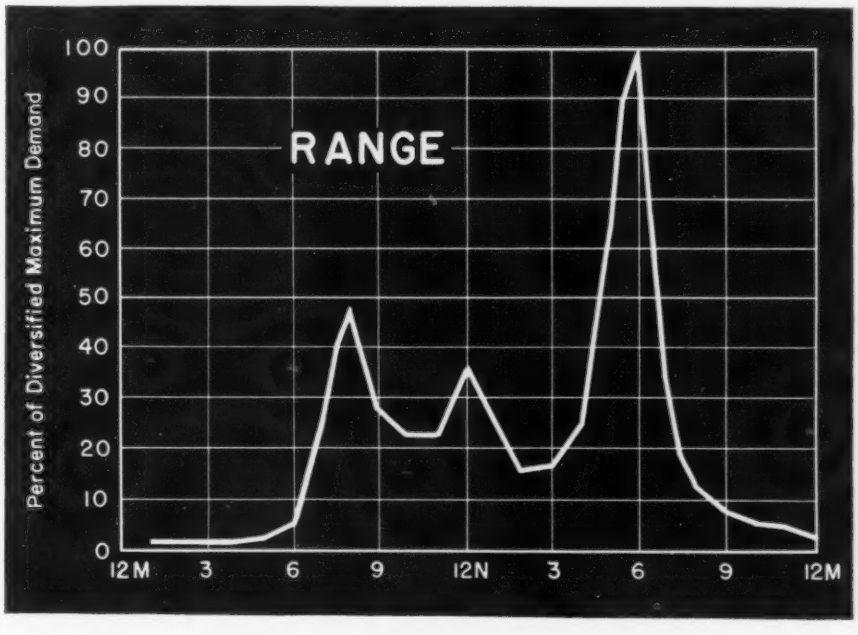
Through study of load characteristics, the Philadelphia Electric Co concluded that for best development of residential load, ranges and controlled water heaters should come on its lines in the ratio of two to one. Sales promotion is geared to that ratio. If the two-to-one ratio is valid country-wide then the utilities had better increase the pressure on range promotion.

Space heating looms as a problem that must be solved. This load will grow regardless of its cost to the user. Technical advances in this field are being made rapidly, pushed along by interests outside the utility industry who have products to sell.

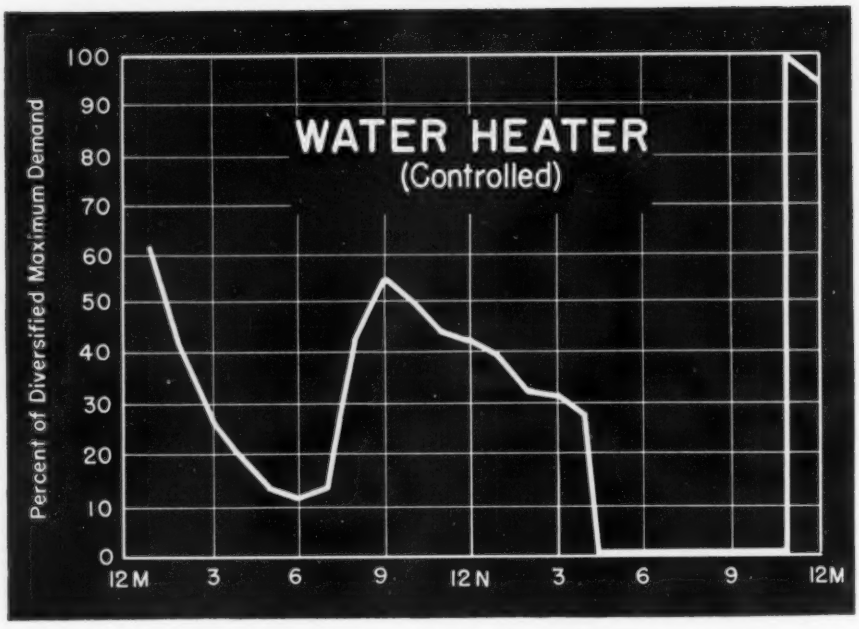
The simple resistance unit has had largest application in space heating so far. It takes two forms; unit heating in different rooms of the house and central heating like the ordinary fuel-fired furnace. Of the two, the unit heater appears the more satisfactory and economical because of absence of heat losses in warm air ducts, availability of different temperatures in different parts of the house and higher diversity factor. Annual load factors are about the same for both.

Space heating has had significant application in only two parts of the nation so far, the Pacific Northwest, and the Tennessee Valley area. Let us glance briefly at the experience in these places.

In the Northwest utilities are not



RANGE LOAD—characteristic winter weekday curve shape



CONTROLLED water heater load—characteristic winter weekday curve shape

altogether happy with the house heating load. This results partly from the fact that people are beginning to want electric heating at a time when capacity is short and partly from the inadequacy of rate schedules. The Seattle municipal system is trying to discourage the growth of this load with higher rates.

From the paper, "Electric House Heating Tests in Oregon," presented at the AIEE 1948 midwinter meeting by W. L. Sharp and A. E. Opdenweyer, Portland General Electric Co, these conclusions may be summarized:

1.—Use of electricity for heating follows the shape of the degree-day curve very closely except in the summer months when intermittent heating occurs.

2.—The maximum heating demand occurs in the morning and lasts about two hours. This demand, averaged to reflect group diversity, is about 50% of the connected load for unit heaters and 58% for central furnaces.

3.—No exact relationship between demand and minimum temperature appeared from the tests. It is more likely that such relationship exists with unit heaters than with central furnaces.

4.—Annual load factor of house heating, based on demand coincident with the evening system peak is approximately 30%. Heating load causes reduction in residential load factor.

Data from the Portland tests are shown in Table II.

One of the most important things in design of an electric house heating installation is to keep excess or reserve heating capacity to a minimum. So says C. E. Simpson, Chattanooga Electric Power Board. This point appears in Table III which shows that demand rises and load factor drops as excess heating capacity increases. Conventional formulas and factors for calculating house heating requirements do not apply to electric installations, he asserts. BTU's from electricity are much more efficiently applied than is heat from combustion.

Mr. Simpson reports cost to the customer of 6.16 mills per kwhr for heating an average 10,000 cu-ft house, inclusive. Total energy for heating is 14,720 kwhr and the season's bill is $90.71.

Fuel Cost an Obstacle

Of course, in both the Northwest and in the Tennessee Valley area, generation is predominantly hydroelectric. Costs for incremental energy production are lower than for fuel power. With coal at present prices and apparently going higher, there is practically no prospect of house heating at cost of around 6 to 7 mills per kwhr where electricity is produced from fuel. However, it should be kept in mind that cost will become less and less of a deterrent to people who want the comfort and convenience of electric heat.

Many problems remain to be solved before the heat pump becomes a really important factor in the home heating picture. As with any new development, equipment must be improved. But the principal difficulty is the source of heat—water, ground or air. As experience accumulates, it becomes more and more apparent that the coefficient of performance of the heat pump (C.O.P.—ratio of electric energy input to heat energy out-

TABLE II— Averages Of Data For 12 Months Ended January 31, 1947, On Electric Heating Installations

	Unit Type		Central Furnace	
Degree Days	4308		4308	
Minimum Temperature—Degree F Jan. 15, 1947	22		22	
Average Number of Houses Under Test	28		21	
Average Size—cu ft	10,082		10,382	
Average Connected Heating Load—Kw	15.3		16.4	
Average Annual Energy Use—Kwhr				
All Service	20,372		23,751	
Heating Only	13,040		16,779	
Other Uses	7,332		6,972	
Heating Kwhr per cu ft	1.293		1.616	
Heat Factor—Kwhr/degree day/1,000 cu ft	0.300		0.375	
Maximum Coincident Demand—Kw				
All Service 9:30 AM—Jan. 15, 1947	9.1		10.6	
Heating Only 9:00 AM—Jan. 15, 1947	7.7		9.5	
Other Uses 4:00 PM—Mar. 16, 1946	2.3		2.3	
Coincident Demand on System Peak—Kw				
All Service 6:00 PM—Jan. 14, 1947	6.8		18.8	
Heating Only 6:00 PM—Jan. 14, 1947	5.1		6.7	
Other Uses 6:00 PM—Jan. 14, 1947	1.7		2.1	
	1	2	1	2
Heating Demand Factor—%	50.3	33.3	57.9	40.9
Annual Load Factor—%				
All Service	25.6	34.2	25.6	30.8
Heating Only	19.3	29.2	20.2	28.6
Other Uses	36.4	49.2	34.6	37.0

Column 1—Based on "Maximum Coincident Demand"
Column 2—Based on "Coincident Demand on System Peak"

put) must average 4 or 5 before this means of home heating can become significant as an electric system load.

Post-war plans for production of home food freezers were born out of the food-saving psychology of the war years. In its May 26, 1945 issue, Electrical World published estimates of prospective home freezer sales compiled from manufacturers' figures. Some of these estimates were extremely high. The average of them for 1947 was 463,000 freezers to be sold, quite close to Electrical Merchandising's estimate of 450,000 actually sold by manufacturers in that year.

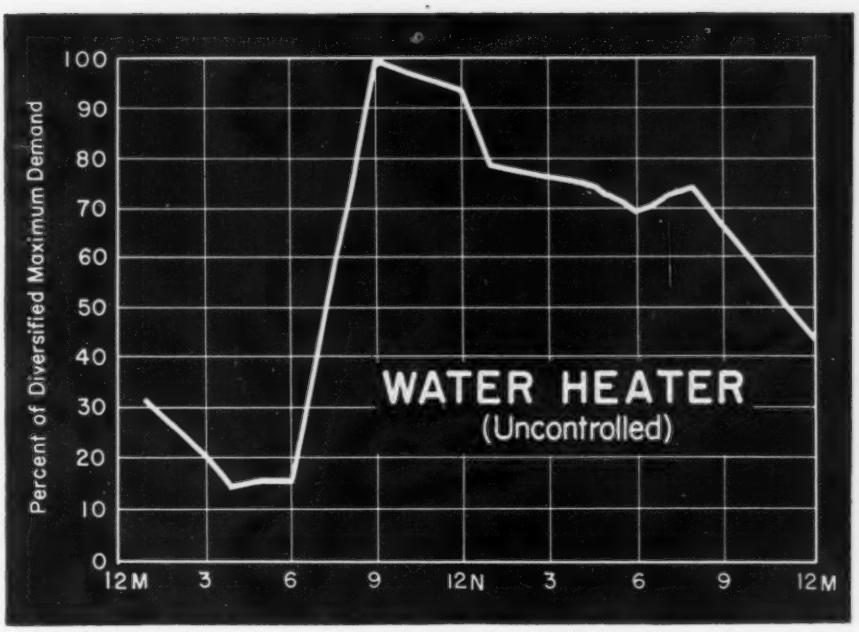
Not Going So Good

Yet, "Perhaps the most disappointing appliance, so far as sales are concerned, is the home freezer," says a survey of appliance dealers made by McCall's Magazine in 1947. "Here is a product," continues the survey, "that was touted to the skies. It was certainly going to be a big volume item. According to manufacturers in general, the home freezer was one product that Mrs. Homemaker would just about break down the dealer's door to get."

But she didn't. Reasons include: 1) much of the food-saving fervor evaporated when the war ended; 2) prices of freezers are too high; 3) the lift top design is inconvenient; 4) manufacturers thought they had a waiting market when actually it was a potential market requiring intensive educational and sales effort.

Undoubtedly the home freezer will become an important user of electricity in some homes. In the smaller towns, in rural communities and on farms freezers are being sold. But in the larger cities where shopping is convenient and people are not used to laying in stocks of food, the modern refrigerator with its enlarged storage space for frozen foods seems to be preferred.

When the first television sets appeared on the market, some utilities feared the effect they would have on revenue. People would be turning their lights off and sitting in the dark in order to see the picture. Then an exactly opposite idea bobbed up. The television image would be so bright that, to protect the eyes, additional lighting of as much as 500 to 1,000 watts would be required.



UNCONTROLLED water heater load—characteristic winter weekday curve shape

At the moment, the effect of television on lighting, if any, can only be guessed and no one has much more than his own estimate of its load characteristics. One hears that the average set will be operated 15 hours per week and will take 200 watts. That's easy to figure—156 kwhr per year. But when in the day will the maximum load occur? What will be its diversity? Can it be expected that, in respect of energy requirement, tomorrow's television set will not be greatly different from today's? And what about the possibility of excessive load peaks when public interest is concentrated on some televised event—a heavyweight championship fight, for instance? These, and like questions, must be answered.

Here are some informed estimates: Production of television receivers, 1947-180,000; 1948-750,000; 1949-1,500,000; 1950-3,000,000; 200 television stations in 75 cities by the end of 1949; over 30 million people within the range of television today; 65 million by 1950.

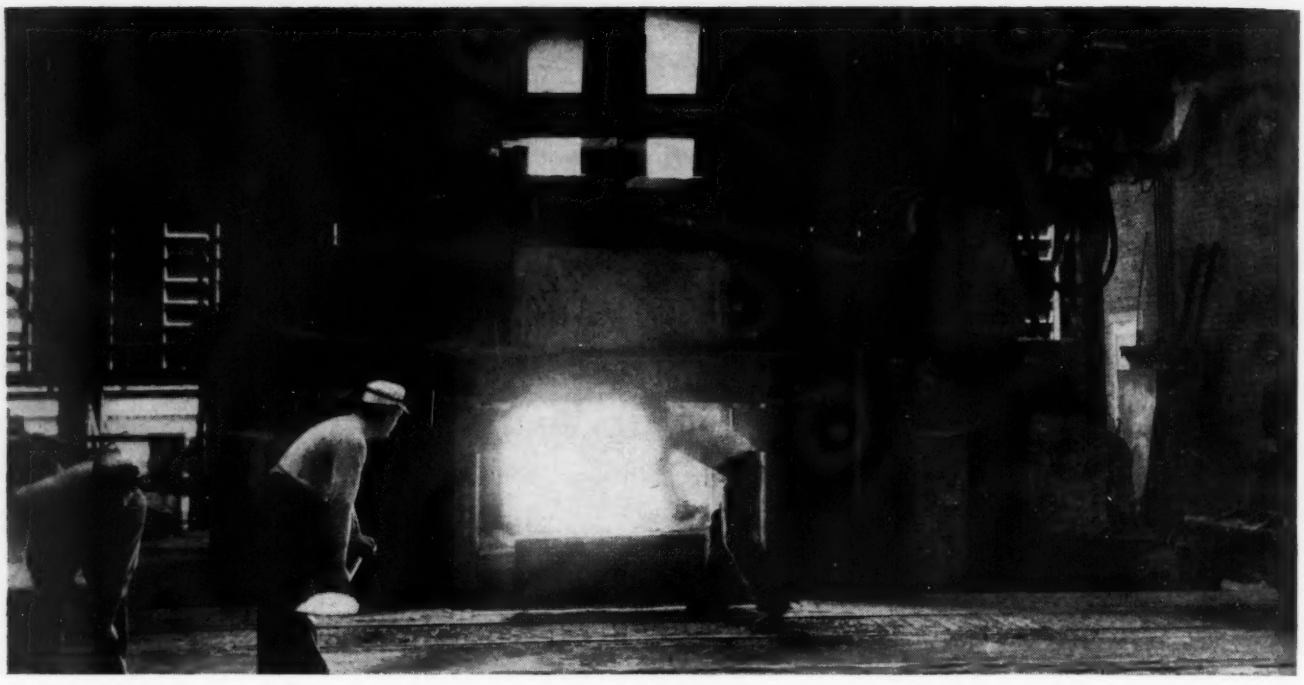
These are impressive figures, but they tell nothing about the effect television will have on residential load characteristics. It is known that the load will develop first in, and may for long be confined to, the large centers of population. About 60% of receivers today are in the New York area. And, too, although the figures of estimated receivers production are big by themselves, they shrink in comparison when stacked up alongside 33 million residential and rural customers. Certainly, television will not be a major concern in residential load research for a while yet.

The examples of residential load discussed here show that explicit data on them are desirable, if not actually necessary. Such data are necessary properly to proportion and to integrate loads of individual applications into the total residential load to earn the best return on investment.

TABLE III—Heating Load Demands And Load Factors For Average 10,000-Cu-Ft House, (Chattanooga, Tenn. Tests)

Reserve & Excess Capacity—%	Installed Capacity—Kw	*Average Customer Max. Demand—Kw	*Monthly Load Factor—%	**Annual Load Factor—%
20	12.7	12.0	54.8	21
40	14.8	13.7	48.0	19
60	16.9	14.9	44.1	17
80	19.0	15.5	42.5	16
100	21.1	16.7	39.6	15
120	23.2	18.4	35.8	14
140	25.3	20.6	32.0	12
160	27.4	23.4	28.2	11

*900 deg.-day month, minimum temperature 10 deg. F (coldest month).
** Includes 600 kwhr per month for other than heating use.



ARC FURNACE produces superior alloy steels and is a large user of electricity

Industrial And Commercial Loads

Because of comparatively small numbers of these customers and wide range of their electricity uses, load research among them is more a matter of individual than of class study

NATIONALLY, industrial utility customers at the start of 1948 were only 0.5% of the total connected, and commercial customers 13%.* The 0.5% of customers bought 52% of the energy sold in 1947 and supplied approximately 29% of the revenue. The 13% took about 18% of the energy and contributed 27% of the revenue.

Although relatively small numerically, industrial customers are often the largest determinants of system load curves. Time and height of peak are freqeuntly fixed solely by industrial load. Since peaks and load curve shapes are basic factors in costs of electricity supply, knowledge of industrial load characteristics is a necessity for competent utility management.

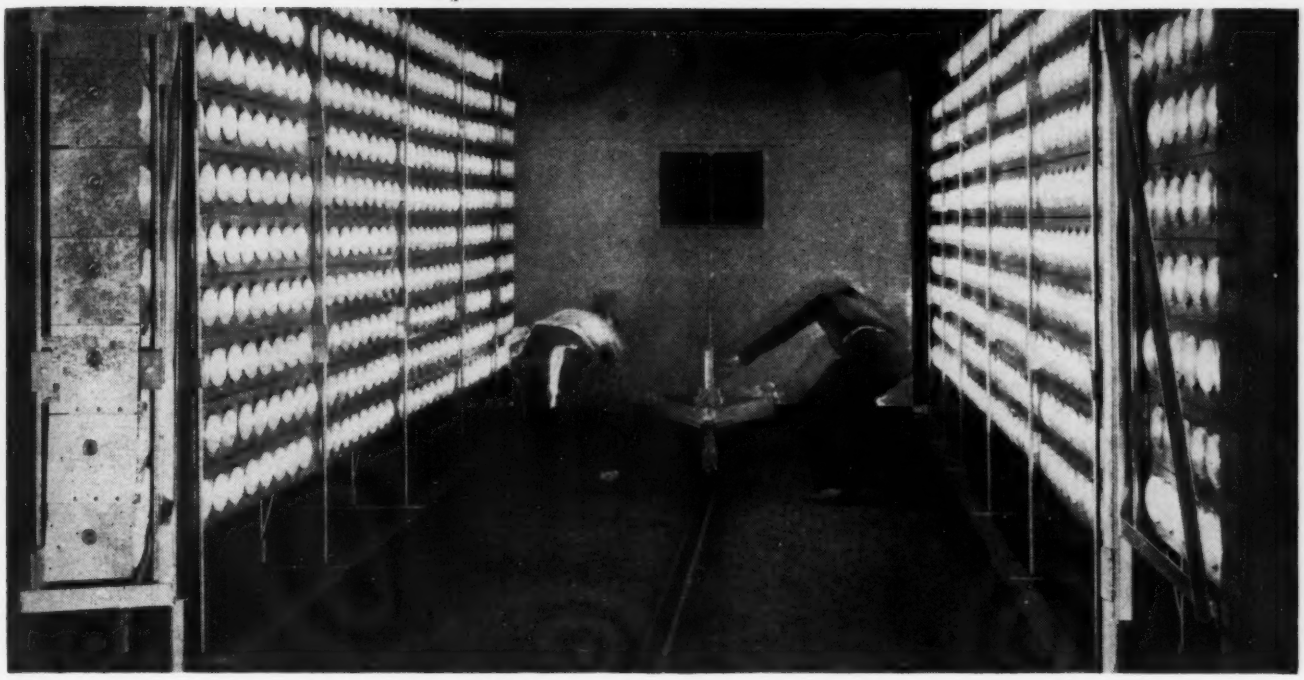
Behavior of load of an industrial customer is much less a function of characteristics of power applications than of conditions affecting them. These conditions may be extremely variable as between customers and as to time. Thus it is not possible in industrial service as it is in residential, to adduce from the characteristics of a given load component how these characteristics will manifest themselves in the composite of a group of customers. For instance, the characteristics of range load can safely be assumed to be fairly constant among a group of residential customers. But it can not be assumed that the load characteristics of identical motors are the same among a group of industrial customers, nor even in the load of one customer.

For this reason, load research in the industrial customer class for system operation and design purposes requires study of load characteristics of individual or small groups of customers. Usually the demand and energy quantities in customer billings give the wanted data.

For load building planning knowledge of characteristics of industrial electric applications is also necessary. Studies of these characteristics may reveal opportunities for filling in load curve valleys or for flattening peaks. Such knowledge gives specific direction to sales effort. For example, substitution of a continuous flow heating process for batch operation may not only reduce production cost for the customer, but also cut down the maximum power demand. Or, depending on conditions, the same results might be obtained by changing from continuous flow to batch processing. From the sales standpoint, industrial load research is the getting of intimate knowledge of customers' operating conditions and of the electrical applications that are and can be incorporated in them.

Because of their high load factors and concentrated use, unit revenue from large industrial customers is less than from any other customer class. In general, industrial load makes rates for other customer classes lower than they would have to be

* These are the classes designated in industry statistics as "Large Light & Power" and "Small Light & Power." It is not accurate to call them "industrial" and "commercial," because there are some commercial customers in the large light and power class and many industrial in the other. But the statistical segregation is the only one we have. It separates the two classes as above and be'ow 50 kw of maximum demand.



INFRARED takes on any size job from baking the finish on a trailer on down—or up

without it. Because the industrial load is a necessity in utility service, because it is growing fast, and because its unit revenue is least, maximum efficiency in use of capacity required by these customers is essential. Progress in this direction can only be along the road opened up by load research.

Earl Kavanaugh, Detroit Edison Co, from his long experience in power sales, says that the largest growth of industrial load will be in applications of electric heat. Even so, mechanization of processes and operations will greatly increase the use of electricity in motor applications. And lighting is nowhere near its ultimate in the industrial field. Industrial load research must cover a wide range of apparatus and equipment for present and potential uses. It must disclose the characteristics and behaviors of components of existing loads, and show how those loads can be improved in kind and quality by new uses and by better utilization of old ones.

Electric heating takes many forms. By resistance, induction, radiation, capacitance, and the arc, electricity is applied to many methods of welding and brazing of metals; to the melting and exactly controlled composition of alloys; to the fixation of surface coatings and finishes; to the setting of bonding agents and the working of plastics; to the curing and preservation of foods and other products for human and animal consumption. The list is practically endless. Everywhere in industry are existing and possible variations of electric heating.

As mechanization of production processes increases, competent industrial load development will require more knowledge of the operations of customers, according to R. G. Ely, Public Service Electric and Gas Company. This will include industrial engineering problems, materials handling, process heating, motor applications, control methods and instrumentation. It will help customers attain minimum unit costs of production through complete electrification. This broadens the field of load research.

Another Research Field

Joseph S. Schuchert, Duquesne Light Co, prime mover in the "Planned Lighting Program," estimates that less than a quarter of American industry is lighted up to modern standards. Not enough is known about lighting as a component of industrial load and what is known is not known widely enough.

The commercial load (13% of customers) is more amenable to statement of average load characteristics than the industrial. It contains about 26 times as many customers. Still it is less than one sixth the size of the residential class and is more difficult to study. Between individual commercial customers there are great differences in sizes and characteristics of loads. Also many of them such as offices, small shops, service stations, are widely dispersed through residential areas. Relatively it is easy to survey comparatively large groups concentrated in business districts. But usually such groups include the larger customers and, without correction and weighting, are not representative of the class.

Load surveys of these customers give certain indications. For smaller customers with individual load factors around 10%, the addition of 2 kw of load at the customer's meter will cause an increase of 1 kw of diversified load, a 2 to 1 ratio. For larger customers with higher load factors the ratio is about 4 to 3. The peak demand of commercial service comes 2 to 3 hours earlier than the peak of residential service if domestic range saturation is low. As range saturation increases, the residential peak demand comes earlier in the day and the diversity between the two loads diminishes. Change in group monthly load factor of a number of commercial customers having individual load factors of less than 20% is slower than changes in the individual load factors. Higher diversity among low load

COMMERCIAL LOAD DEVELOPMENT finds promise in lighting and cooking installations such as these

factor customers is the cause. Even when individual load factors are high, diversity is still appreciable. At about 20% individual load factor, diversity factor is about 1.33. As the load factor rises to 75%, the diversity factor slowly declines to around 1.15. Since low load factor is a characteristic of many commercial customers, there is a considerable field for sales effort in this customer class before group demands increase greatly.

Cooking and air conditioning loads are of rapidly growing importance in commercial service. A survey made in Philadelphia reveals the load characteristics of light-duty or counter-type cooking equipment. From a list of 200 well equipped customers, a sample of 84 was selected in 3 groups: 1) 23 restaurants, 2) 24 drug stores, 3) 18 lunch rooms, 12 taverns and 5 "diners." Principal conclusion was that in the local conditions most benefit for the utility would be realized by a ratio of not more than 3 to 4 between connected load of counter cooking equipment and total connected load of the individual customer. This ratio gives the sales department a definite aim in sales promotion to these customers.

Air conditioning is not a load enthusiastically welcomed by utilities generally. It has become a problem to be met, rather than a load to be promoted. One aspect of the problem is that large growth of air conditioning load may move the system peak from winter to summer. This requires a change in the scheduling of inspection and maintenance of generating equipment and puts the heaviest load on the system at the time of year when it is hardest to carry. This is a most important consideration in these days of capacity shortage.

The other troublesome thing about air conditioning is that people usually wait until the temperature is 90 in the shade before they decide to buy it. Then they want immediate service. Such a rush of connection work results that some customers have to wait, often for quite a while, and they do not like it.

Controlling By Promotion

The Potomac Electric Power Co has seen its system peak shoved into the summer months by air conditioning load. And it has had the experience of customers crowding in clamoring for immediate connection of newly-bought air conditioning equipment and then clamoring more loudly because they had to wait.

This company realizes that its air conditioning load will continue to grow and must be served. But instead of dropping air conditioning out of load building activities, the company reasoned it would be better to leave it in. Accordingly a fullfledged campaign of air conditioning promotion was put on last winter to promote early installation of equipment before the summer season. Returns from it are giving the company a reasonable estimate of what customers' requirements in new air conditioning installations will be next summer. The work of handling connections is being done in an orderly and systematic way and the bottleneck caused by a mad scramble of customers demanding service all at once will be broken.

Practically all of the assembled data on air conditioning are pre-war. They are not extensive enough to allow statement of average characteristics of the load. Because of this and also because climatic differences are great, about the only safe general conclusions are that the load is concentrated in the summer months and that its annual load factor is lower than is desirable.

The foregoing remarks refer to air conditioning in its most common meaning, air cooling for human comfort. In its complete meaning as the maintenance of optimum conditions of air temperature, humidity, cleanliness and movement, as it is in many industrial and some commercial applications, air conditioning is a load of desirable characteristics.

Because industrial and commercial loads are so diverse in kind and size and are so affected by conditions of locality and time, they can be discussed only in generalities. For these same reasons, research into their load characteristics in the local and current scene is necessary for competent load planning.

Load Development Planning Based On Diversity

Recently acquired knowledge of how consumer and class loads integrate themselves into system loads provides rational basis for load building activities

ELECTRIC UTILITIES have one reason for existence: They can supply electricity to users at less cost than users can produce it for themselves. This single reason rests on two bases. They are mass production and diversity. The discussion here is diversity and its importance as a determinant of planned load development.

Diversity results because all uses of electricity are not simultaneous. It exists between different uses of energy by one customer, between individual customers, between groups of customers in one class, and between classes of customers. Diversity reduces the capacity to supply electricity for given uses by given customers from that required if those uses or those customers were each supplied by single productions. Thus diversity is the prime determinant in cost of electricity supply facilities. As such, it has received much study, particularly as to its effect on system design.

For many years, only the most obvious aspect of diversity has been recognized as a factor in load development. Desiring to fill the valleys of their load curves, utilities have promoted the use of their service during off-peak times by sales efforts and rate inducements. Only in recent years has diversity had any rigorously detailed investigation in terms of (1) load characteristics of individual uses of electricity, (2) ways these uses combine into load totals of single customers, and (3) of groups and classes of customers. As knowledge increases of how uses go together to make load totals, the next step comes up for consideration. This is to direct the development of electricity uses in quantity and character so as to make the resulting load totals desirable in terms of greatest economy. This is planned load development.

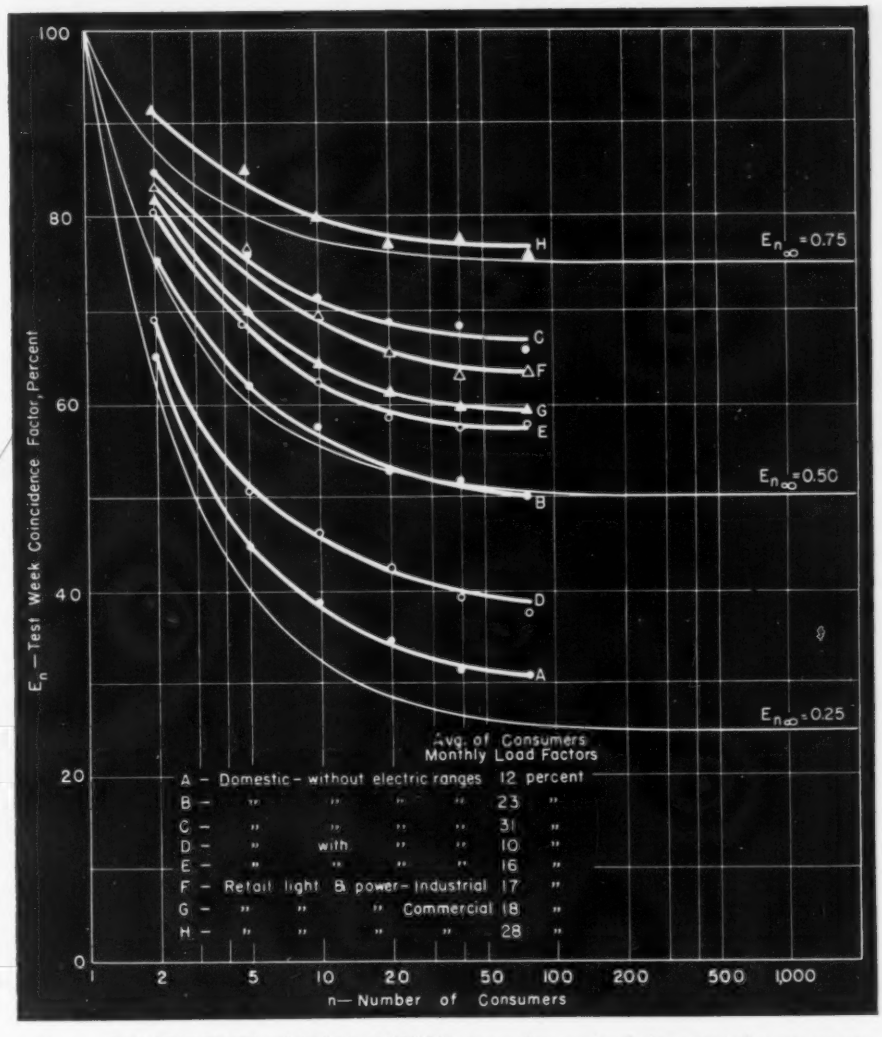


FIG 1—COINCIDENCE FACTOR CURVES depending on load characteristics are asymptotic to limiting minimum values as number of consumers increases. Curves A, B and C are for monthly average load factors of 12, 23 and 21% of residential consumer groups without ranges; D and E for 10 and 16% load factors of same groups with ranges; F for an industrial consumer group of 17% load factor; G and H, commercial groups 17 and 18% load factors

Diversity factor is the ratio of the sum of the maximum power demands of subdivisions or parts of a system to the maximum demand of the whole system. A "whole" system may be comprised of the facilities to serve one customer, a group or class of customers, or all customers. Turning that definition upside down, results in coincidence factor.*

While diversity factor can range

* "Coincidence-Factor Relationships of Electric-Service-Load Characteristics," Constantine Bary, AIEE Transactions, Vol 64 pp 623-628

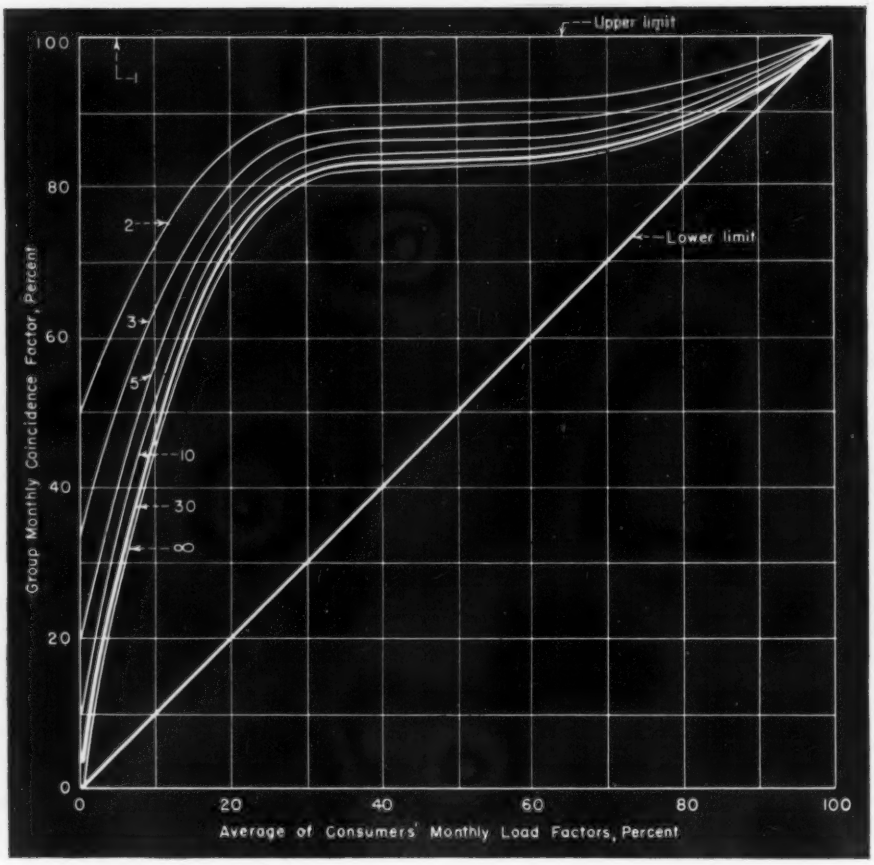


FIG 2—GENERAL SHAPE of coincidence factor curve plotted against average of consumers' load factors. Curves in the set were constructed for numbers of customers, as designated, from one to infinity

from one to infinity; coincidence factor is confined between zero and one. This limitation on coincidence factor makes it more amenable to mathematical handling. Another special merit of coincidence factor is that it is in direct relationship to the amount of facilities to serve a given load or group of loads while the relationship of diversity factor thereto is inverse.

Coincidence factor has two important associations, each of which leads to significant conclusions in load development. One is association to number of consumers and the other is to load factors of consumers.

Plotting coincidence factors obtained from test and record data against numbers of consumers results in curves of hyperbolic shape, as shown in Fig 1. These curves indicate that for a given set of load characteristics coincidence factor approaches a lower limit as number of consumers is increased. The practical significance of this indication is that statistically stable results in terms of diversity may be obtained from load researches covering as few as 100 consumers. For results to be used for engineering and load development determinations, the number of consumers of homogenous types, that is, in the same customer class and having the same kinds of load, can be as low as 30 to 50.

The extent of time coincidence of any group of loads is proportional to the load factors of the individual loads in the group. But in what way it is proportional is a question that had received little elucidation until the coincidence factor thesis was brought forward.

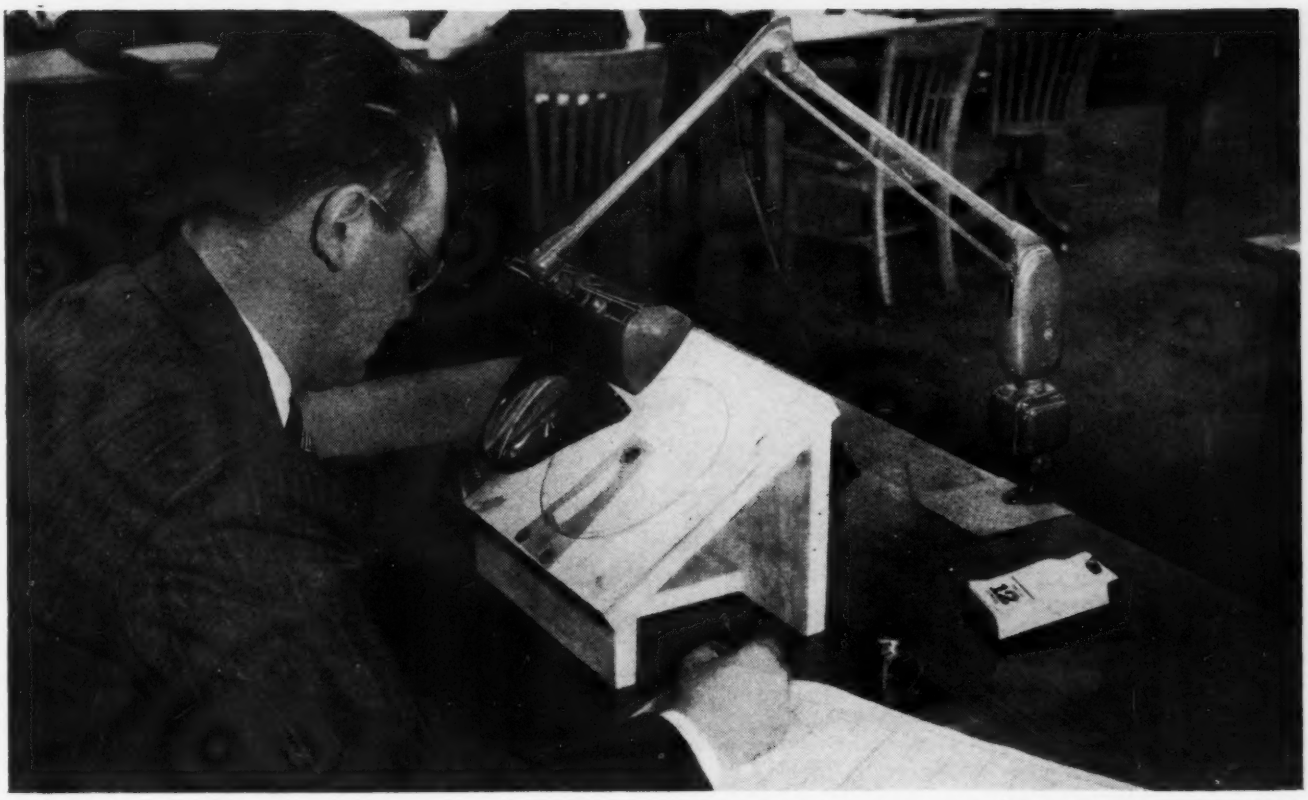
A group of consumers will have a coincidence factor of 100 percent if each consumer has a load factor of 100 percent. Also if each consumer has a load factor approaching zero and his use of service is unrestricted as to time, the coincidence factor of the group will also approach zero as the number of consumers increases. Further, the coincidence factor of a group of consumers, each of whom has the same load factor, can never drop below the value of that load factor. These limits can be set graphically as in Fig 2. The values of coincidence factor, plotted against averages of consumers' load factors, will be always in the upper diagonal half of the graph.

The general shape of the coincidence factor—load factor curve, as plotted from test data and as determined by probability calculation, says that coincidence factor increases rapidly as consumer load factors rise to an average of 20 to 30%. Then as average load factor rises to 60 to 70%, the coincidence factor curve remains quite flat. It turns sharply up again for average load factors of 70 to 100%. From this shape of curve it is to be concluded that for any group in which the average of consumers' load factors has reached a certain level, it is possible to raise those load factors considerably without appreciably raising the coincidence factor.

This conclusion is of major importance in load development. It allows extensive load building activities to be carried on without greatly increasing the required service facilities.

As bases for planning of system or of load development by any utility, coincidence factors of various group and class loads must be determined by test and research in the local conditions. It may not be taken, for instance, that the coincidence of electric range loads is the same everywhere. Nor may it be assumed that load coincidences remain constant in time. Habits of life, business practices, climate, all the influences of environment and economy that determine the ways that people work, play, eat and sleep, have their effect on the characteristics of use of electricity. These influences are not static; they change with the times. Also the devices and appliances that use electricity are continually being changed and improved. Therefore, to produce data valid for planning in any particular case, load research must be local and continuous.

Only in this way can the definite components of a desired system load be obtained. No utility, if any want to, will be able to avoid load growth entirely, not even by high rates or by failure to promote use of its service. The only question for a utility to decide is what kind of, and how much, load growth it wants. For this decision, complete current knowledge of load characteristics in the local scene is needed.



CHARTS ARE CENTERED on a low boss on an inclined board and rotated by hand for reading. Successive demand curves appear under a celluloid strip with a slot whose right-hand side coincides with the printed time arc on the chart. The 4-power magnifying glass and lamp are a commercial unit such as used for inspection and assembly of small parts

LOAD RESEARCH METHODS

Purposes of studies . . . Sampling procedures . . . Assembly of information to put study reports on comparable bases . . . Compilation practices

LOAD RESEARCH may be undertaken for one or more reasons. To determine the factors of system design is one. Another is to develop data for analysis of existing rate structures or for setting up new ones. A third is to establish bases for planning load building.

Whatever the reason for load research, the data sought are the same. In one case more detailed data may be necessary than in another. For system engineering purposes, for instance, research may stop at the distribution transformer. But for load building planning, knowledge of single or group customer loads is required. Such a load study must be carried right into customers' premises.

Data to be secured by load research are actual maximum and average maximum demands, energy consumptions, load factors, diversity factors, coincidence factors, (reciprocal of diversity factor) and sometimes power factors.

These quantities and factors may be determined for individual customers or groups of customers, kinds of loads, or grouping of loads. However derived, they are related to times or periods of time significant to the particular study.

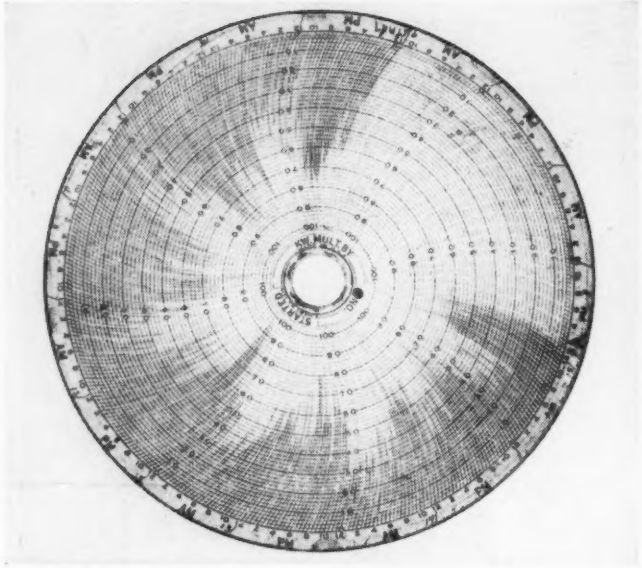
"The purpose of load building planning" says Harris Dexter, Central Hudson Gas & Electric Co, "is so to direct total load increase that it will have most favorable effect on net revenue. This means that the planners of load building must know what loads to sell and where to sell them."

To furnish this knowledge, load research must extend to load origins. This includes major appliances and applications in customers' homes, and principal uses in factories, stores, offices and other business places.

It is not necessary to check the loads of all customers individually in any large class being studied. A carefully selected sample, or a number of them, will reflect the characteristics of the whole reasonably well.

Sampling can be done in two ways. "Mass-average" sampling simply takes a sample of the whole. "Selective" sampling divides the whole into parts of like attributes and takes a sample from each part.

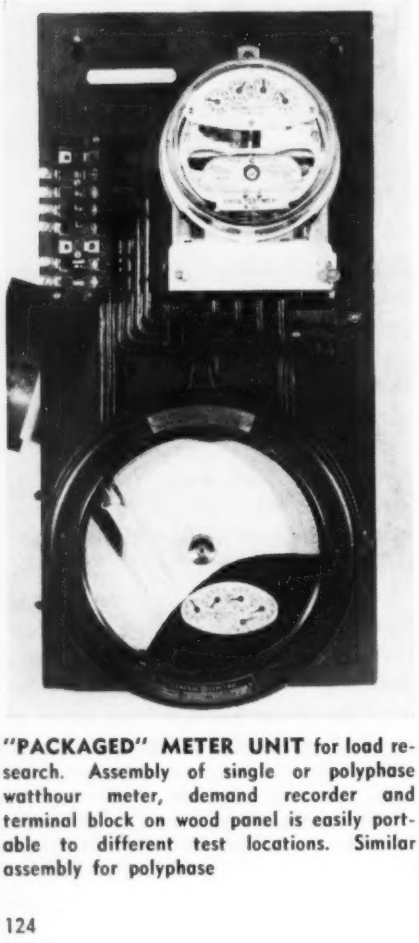
The results of mass-average sampling are representative of the whole only, and only of the particular whole studied. For instance, such a study



OUTSIDE-ZERO DEMAND CHART may be for 8, 16 or 32 days and for 15-, 30-minute or one-hour demand intervals. Chart rotates under arc profile of brass strip. At right, another chart-reading device

Strip has cleats under which scales corresponding to different meter constants may be inserted. The chart then becomes direct-reading and multiplying is avoided

of residential load characteristics in one community tells little or nothing about the characteristics of the various components of it. Data obtained in that one community are not always valid for others. The proportions of the components in the whole load may be different as between one community and another.



"PACKAGED" METER UNIT for load research. Assembly of single or polyphase watthour meter, demand recorder and terminal block on wood panel is easily portable to different test locations. Similar assembly for polyphase

In selective sampling, the class of customers is divided into groups. Each of these is composed of customers with attributes of energy application and use as nearly alike as the study may require. Residential customers can be conveniently segregated into 4 groups. The first includes customers with lighting and small appliances only. The other three are of customers whose uses are successively larger by the additions of refrigeration, cooking and water heating. Thus the major groups would be of 2, 3, 4 and 5 uses, each having particular characteristics. Generally these groups should be subdivided according to energy consumptions.

Setting up of groups and subgroups requires judgment to avoid inclusion of extraordinary customers, which would distort survey findings and affect average data unduly.

Whether mass-average or selective, samples should be selected by random choice. An ideal sample fulfills two conditions. It represents the whole quantitatively and qualitatively. It should be large enough to supply stable averages of data. And it should reflect the characteristics of the whole. Each of these conditions may be tested mathematically as the load research is carried on.

The quantitative test is simple. Suppose there are 100 customers in a sample as first selected. Compute data averages for successively and uniformly larger parts of the 100. Start, say, with 10. Then take 15, 20, 25 and so on. If the averages for the successively larger groups soon settle down to fairly constant values, settle down towards the end of the process, or do not do so at all it is to be concluded that the sample is unnecessarily large, about right or not large enough.

Coincidence Factor Check

At conclusion of a test a further check for assurance that a given sample was sufficiently large is to plot coincidence factor (See Fig 1 and text, page 121) against number of customers. As this factor declines, its curve flattens out. Where the curve is judged to have become sufficiently flat, the number of customers was enough for a sample.

Attainment of stable averages of data is not proof that the sample accurately represents the characteristics of the whole. But usually it is pretty good evidence that it does. Accepting this assumption avoids testing the qualitative merit of the sample by the mathematics of probability. This testing is something to be avoided, according to F. M. Terry, Consolidated Edison Co of New York, who has long been associated with load research for a long time.

Data for load building planning should be obtained from meters installed on customers' premises. At

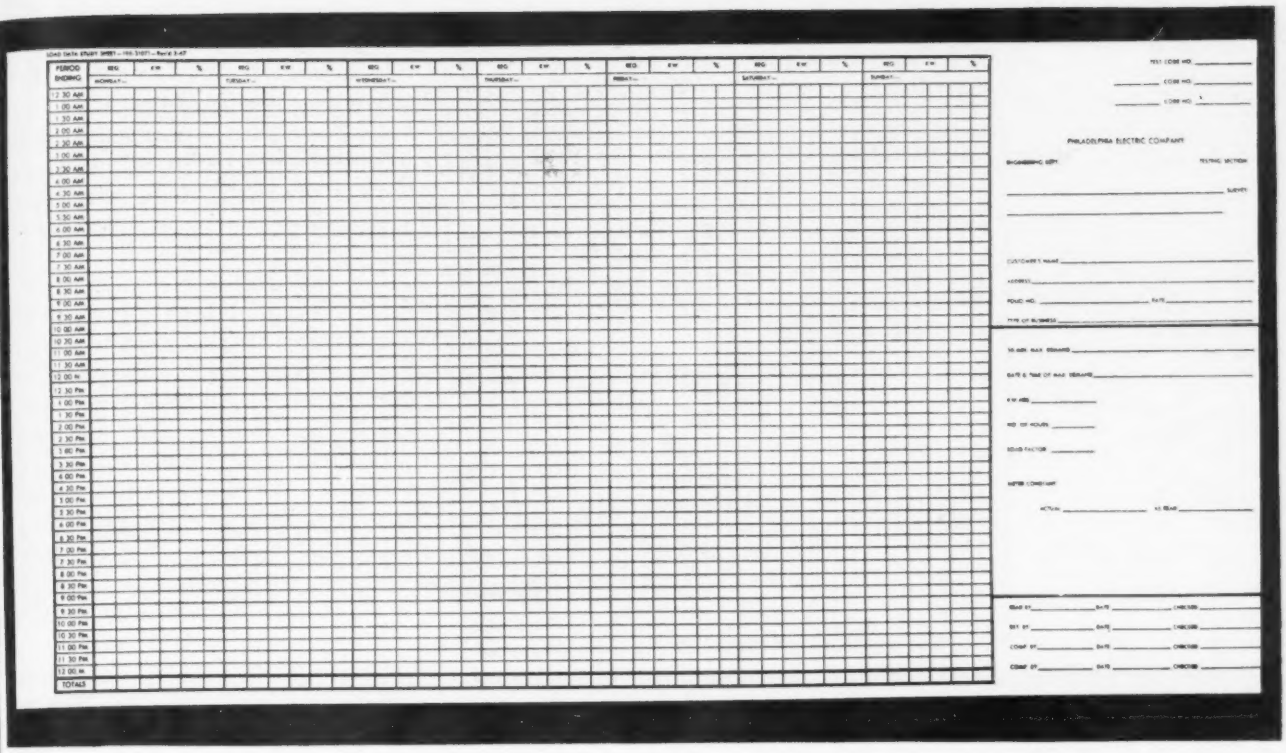


CHART DATA are entered on a load-study data sheet covering a week's readings at 15-minute or half-hour intervals

least one meter is already there, the watt-hour meter. Additionally a graphic wattmeter or other type of demand recorder may be required. Power factor data will call for suitable other metering.

Ideally, a load research period should cover a year. But this is seldom practicable. Periods of two weeks or, if possible, a month, in summer and winter will furnish data of seasonal extremes, sufficient for most purposes of load analysis.

Selective sampling from groups of customers of homogenous load conditions produces data indicating trends and characteristics. These data are indicative of where particular characteristics of loads—ranges, water heaters or whatever—are tending, and of how development of specific loads may be directed by sales effort for desired results.

An important value of load research data is their possible utilization by utilities other than just the one that made the study. In assembling and reporting result of load research, it is desirable that data be in terms usable by other utilities. Here are some suggestions:

If the research covers a group of residential customers, they should be specified as to location such as urban, suburban or rural;—racial origin or nationality; type and extent of employment; types of dwelling unit such as detached or row houses, flats or apartments—large, over 7 rooms; medium, 5 to 7 rooms; small, under 5 rooms; age, rental or value of dwellings; number of occupied and unoccupied dwellings, and equipment and appliances in use such as refrigerators, ranges, water heaters, oil burners, and air conditioning.

Details Of Data

Test meter readings should be compiled and assembled to show, in tabulated or graphic form or both, as much of the following data as is necessary for a complete picture:

1—Date, time of day, and amount per customer of the annual maximum coincident demand of all customers in the group, and of cumulative portions of the group to indicate trend.

2—Same as (1) except that data are for the time of maximum load on the substation from which the group is supplied.

3—Same as (2) except that data are for the time of maximum load on the generating or other system supplying the substation.

4—Sum of individual maximum demands of customers in the test group and cumulative portions of the group regardless of time of occurrence of demands. The period of the test should include maximum demands of all customers in the group.

5—Typical winter weekday maximum demand of the group. This should be computed by averaging the group demands occurring at the same time of day for 10 or more consecutive weekdays, excluding Saturdays and Sundays.

6—Same as (5) for summer day.

7—Average monthly kwhr per customer year for all customers in the group and for cumulative portions of the group.

8—Average monthly kwhr per customer for each month in the year and for cumulative portions of the group. Or monthly kwhr for months sufficient to indicate seasonal variations.

From the specified data, 1 to 8, the following factors should be computed:

a—Annual diversity or coincidence factors for all and cumulative portions of customers in the group for indication of trend. Items 1 and 4.

b—Typical winter diversity or coincidence factors as in "a". Items 4 and 5.

c—Typical summer diversity or coincidence factors as in "a". Items 4 and 6.

TOTALIZING individual customer study sheets to obtain group data. Sheets are folded and laid down overlapping so that the same day of each sheet is exposed. Clamps and strips hold the charts in place while demand figures are read across and added together. Totals from the adding machine tape are then entered on the group summary sheet

d—Load factors for all customers in the group, and for cumulative portions of the group to indicate trend. Items 1, 5 and 6.

These data and computed factors should be accompanied by daily load curves showing conditions typical of test periods.

In load studies made specifically for distribution engineering purposes, frequently only demand data are collected. Such studies would have much wider usefulness if energy-use data, allowing calculation of load factors, were included.

If a study is undertaken to determine the characteristics of a particular kind of residential load, it is desirable that the report include information pertinent to that load. In a study of electric cooking for instance, the number of ranges of different types should be reported; range types be described as to capacities and heating units; number of families and average family size, meals cooked per week and hours when cooked, employment of servants, and similar factors be covered.

A water heater load study preferably should give information on families, on number and tank sizes of heaters of various types, on clothes washing done in the home, on manner and time of heater electricity supply control if any, on incoming water temperatures winter and summer, on estimated draw-off quantities and times.

Studies of commercial and industrial loads should derive essentially the same data as are obtained from residential. The information included in them should cover so far as possible numbers and locations of customers, surrounding conditions and circumstances, uses of electricity—lighting, power, heating, refrigeration, etc.—connected loads, energy consumption, demands, all data pertinent to the particular case.

Continuous Research Desirable

Load research carried on by electric utilities varies from comprehensive continuous studies to casual and sporadic investigations. For maximum value, research should be continuous. By making it so, routines for collecting and recording data and for calculating and presenting results can be set up. The work can be organized under the teaching of example and experience so that it can be done with least labor and at least cost, as is indicated by the accompanying illustrations.

One final statement of load research results may take the form of daily load curves for the groups of customers covered in the tests. These curves, expanded to cover whole classes, can be tested for accuracy by combining them plus loss allowances into a single curve for comparison with the system load graph. In the cases of companies well experienced in load research such synthetic curves show remarkably close coincidence with the system load curves drawn from power station records.

One company can obtain a residential load curve for any desired day in the year. Eight-day recording meters are operated continuously at selected points on the distribution system. These meters chart the integrated 30-minute demands of sample customer groups. Types and sizes of dwellings, income levels, living habits, appliances used, and other pertinent facts are known for each group. By making proper correction for differences in saturations of ranges and water heaters between the test groups and the whole residential class, a daily load curve for the class can be drawn from the group data.

Average Of Two Methods

Another company, which has separately metered controlled water heating service, takes sample data from customers with and without electric ranges. These data are expanded and combined with proper weighting according to saturation of ranges and other factors to make a composite of the entire class. Then the class load is again determined by another method, this time by combination of data on the components of load, (1) lighting and small appliances, (2) electric cooking, and (3) refrigeration. The class loads arrived at by the two methods are then averaged to make the final residential load curve.

Only a few utilities do load research continuously. By most, research is done only at such times as up-to-date information on load characteristics is needed. In view of conditions now facing the industry, it is to be expected that more utilities will see the necessity for current and better knowledge of the details of load behavior. Opinion is that rate increases may soon be required quite generally. Also it appears that load development activities must be more informedly directed than in the past. Most systems are confronted with the necessity for expansion of facilities. For all of these, adequate knowledge of load characteristics is essential.

Load Research Findings Help To Foresee Future Conditions

Prediction of conditions and requirements of electric service supply becomes possible through knowledge of load characteristics and of their trends observed from continuous studies

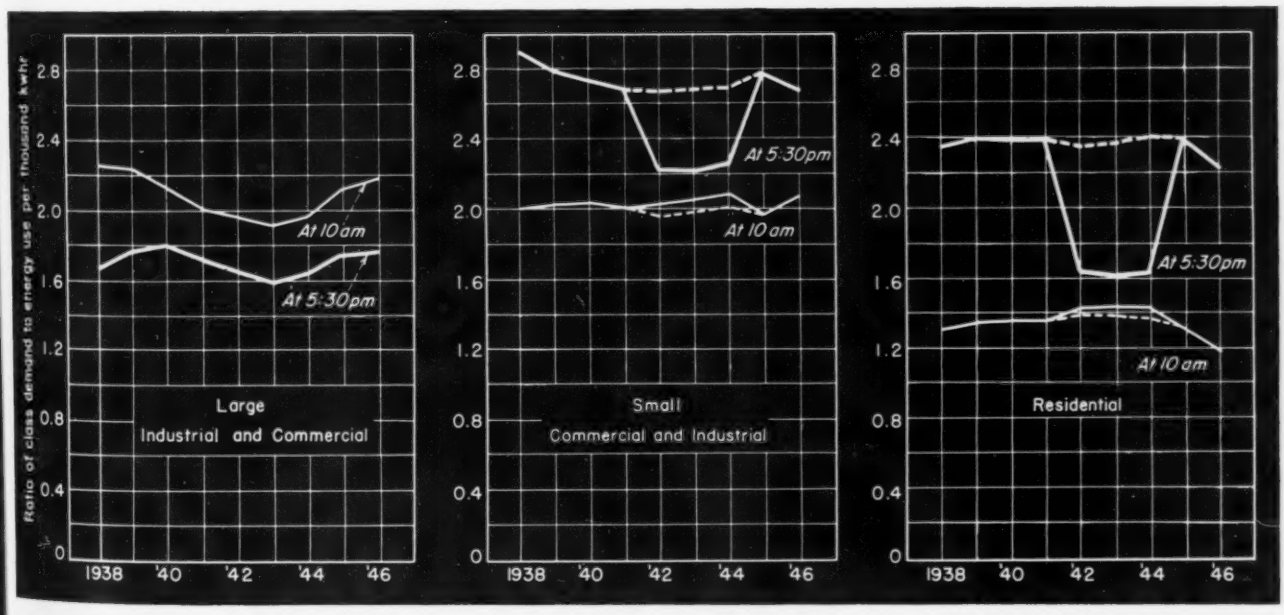
CONSTANTINE BARY
Rate Research Engineer
Philadelphia Electric Co
Philadelphia, Pa.*

THE PRIMARY AIM of load research is to secure knowledge which would enable one to foresee or to predict the effects of changing conditions on the physical and economic features of electric service supply. Through analytical study of observed phenomena present in the various components of the total load, the significant factors of which can be linked by some probable relationships between two or more controlling characteristics, the necessary "tools" for prediction of future load behavior are secured.

In order to enable the human brain to understand the results of such research, it is necessary, as in other scientific endeavors, to simplify complex phenomena by reducing them to

ILLUSTRATIVE DEMAND-TO-ENERGY RATIOS

(Based on average December weekday integrated clock-half hour demands)

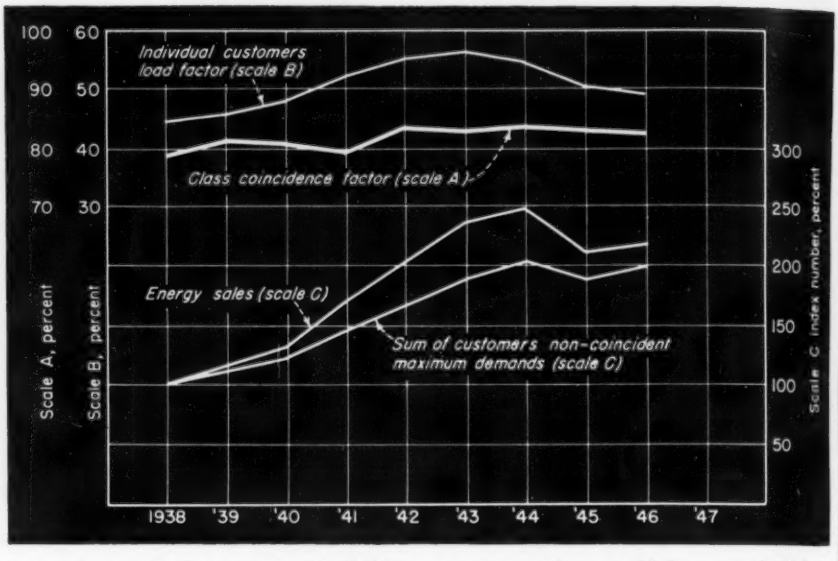


DEMAND-TO-ENERGY ratios at significant times of the morning and evening system peak periods as normally occurring under standard time conditions are different for the three general classes of service. Curves are of ratios of average December weekday loads at 10 AM and 5:30 PM to energy requirements for the month. In peace times the level of the ratio for the large industrial and commercial class at the time of the system evening peak is ⅔ that of the small commercial and industrial class, and ¾ that of the residential. At the time of the morning system peak, the levels of the ratio for the two industrial and commercial classes are not greatly different, and are about 1⅔ that of the residential class.

Differences of this magnitude are of major significance in predicting the physical characteristics of total system load under a widely changing proportion in the energy requirements of these classes. Attention is also directed to the important effects that introduction of "war-time" had upon these ratios for the residential and the small commercial and industrial classes of service in the years 1942-1944. The broken lines show what the demand-to-energy ratios would have been if "war-time" had not been in effect in these years.

* Author's permission must be obtained for re-production of, or quotation from, this article.

CLASS COINCIDENCE FACTORS AND INDIVIDUAL CUSTOMERS' LOAD FACTORS



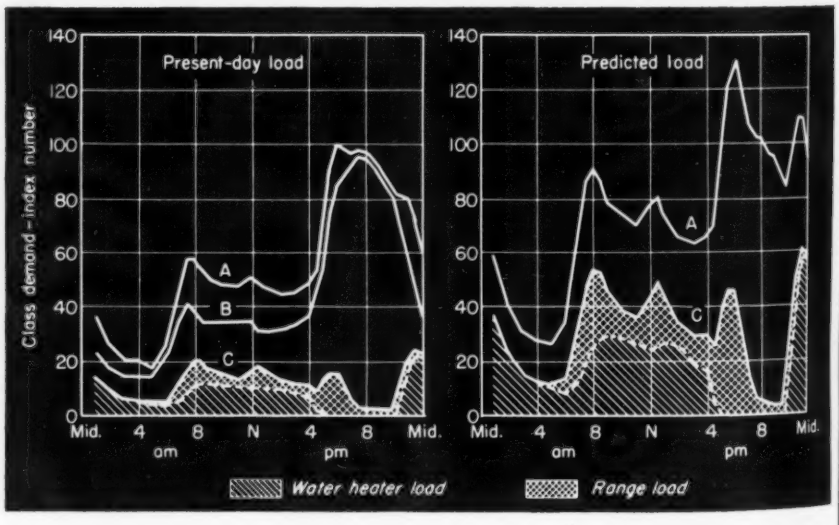
RELATIONSHIP between group coincidence factors and individual customers' load factors was first demonstrated and formulated by the author in 1937, as a result of extensive research on the system referred to in this paper. It permitted the prediction that an increase in individual monthly load factors of industrial customers, from the pre-war level of about 40% up to 70% as a result of war production, would not be accompanied by any substantial change in their group coincidence factors. Experience verified this prediction. Notwithstanding the substantial changes that occurred in the volume of energy and demand requirements of the industrial class of customers during the past decade, their group coincidence factors followed the general trend of the relationship. They remained substantially fixed at a level between 80 and 84%, even though the individual customers' load factors increased by over ¼ from a pre-war value of 45% to about 57% at the peak of war production, and then dropped back to below 50% in post-war period. An error of considerable magnitude would have been made if the assumption, made by some people before the war, had been accepted that for monthly load factors of individual customers as high as 60 to 70%, their group coincidence factor would be 100%. Such an assumption would have resulted in a prediction of a peak load on the utility systems of this country at the height of war production over 2,000,000 kw higher than was actually experienced.

a common element, through the establishment of a conceptional model.

For the present purpose the total load of an electric utility system will be conceived as consisting of components and their elements; the large blocks being the classes of service, and the smaller ones—groups within the classes, composed either of certain specific electric appliances or applications, or of individual customers homogeneous as to some controlling feature of their load. Studies of load characteristics of such elements are directed toward revealing the most probable behavior of the characteristics for the average of individual cases having some common controlling feature. It is only through knowledge of such averages that significant trends are perceived for the mass, enabling the pursuit of the fundamental aim of foreseeing or predicting the features of the mass under a changed composition of its elements or components.

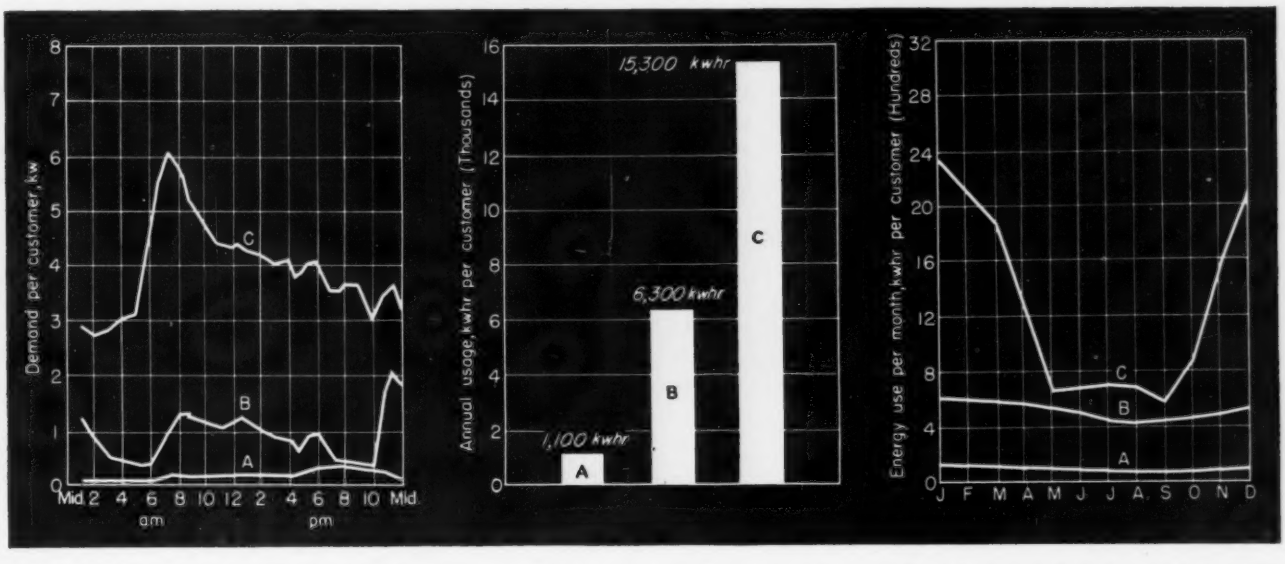
The degree of subdivision of the system load for research into components and elements may vary, depending upon the problem at hand. No one single formula or conceptional interpretation can be set forth here as applicable without modifica-

PRESENT AND PREDICTED RESIDENTIAL LOADS



RANGES AND WATER HEATERS change the shape of the residential class load curve. With adequate knowledge of the load characteristics of these two major appliances, it is possible to predict their effects upon the load characteristics of the residential service class (and, if required, on the system load). Curve A in the left figure represents the total residential load on an average weekday in December, 1946; curve B, the load of the class as it would have been had there been no range and water heater load; curve C, the difference between A and B, or the combined curve of the range and the controlled, fully "off-peak" water heater loads. Corresponding curves in the right figure illustrate the predicted features of the residential class load curve for a three-fold increase in the range load and a water heater load corresponding to a saturation of two ranges to one controlled fully "off-peak" water heater in controlled service.

PROBABLE EFFECT OF HEAT PUMP ON RESIDENTIAL LOAD


Demand per customer, kw
Mid 2 4 6 8 10 12 2 4 6 8 10 Mid.
a.m.
p.m.
C
B
A
Annual usage, kwhr per customer (Thousands)
15,300 kwhr
6,300 kwhr
1,100 kwhr
Energy use per month, kwhr per customer (Hundreds)
J F M A M J J A S O N D

HEAT PUMP will change residential class load characteristics. Because of lack of experience with heat pump load, the data used in constructing the charts were derived from known characteristics of residential gas heating loads. Actual characteristics of heat pump load will depend on design of the machine; on its relative efficiency of performance on cold days in comparison with its overall record for the entire heating season; on margins in heating capacity of the device; on the way human beings choose to operate it whether at a constant temperature setting of the house thermostat throughout the entire 24 hours or at one daytime setting and another at night.

Based on the data of gas heating, the 30-minute maximum demand of the average heat pump was assumed to be 7 kw; its group, or diversified, demand on the average weekday of the coldest week of the winter period—at 4.9 kw; its coefficient of performance (COP) at 3.5 at all times, including the period of maximum demand. The charts show three types of residential customers—A, ordinary use (lighting, miscellaneous small appliances and refrigerator); B, heavy use (ordinary use plus range and water heater); C, all-electric (heavy use plus heat pump).

The charts predict that on the average day of the coldest week the maximum group demand (left) of the all-electric, C, customer will be about 17 times that of the ordinary use, A, and about 3 times that of the heavy use, B. The annual energy requirements (center) of the C customer will be about 15 times that of the A and about 2½ times that of the B. The monthly energy use (right) of the C customer in December, January and February will be over 20 times that of the A and from 3 to 4 times that of the B. But in the summer months the C energy use will drop to 10 times the A and be only ½ larger than the B.

tion to all electricity supply systems. The actual significance of the load characteristics of each system can be appraised only through study and full knowledge of the individual system's conditions and the practices peculiar to its own operations; and similarly any interpretation of details must be made by taking into account existing local conditions. It is possible, however, to offer certain general interpretations, in the broader aspects of their significance, on the applications of some of the major factors and relationships which are of a fundamental nature.

Scope Of Discussion

It is the purpose here to show the practical applications of results of load research which enable prediction of the physical and economic features of electric service supply produced by changes in the compositions and characteristics of the individual components and elements of the total load. This "foreseeing" may take the form of load forecasting, where the element of time is associated with anticipated changes in numbers of customers or appliances, or in quantities of energy use. Or it may be of the nature of predictions made without regard to specific time but with regard to changes in the character or composition of the individual components or elements of the total load.

The illustrations of load research results presented here are confined to three general types of data: 1) service load curves, or the hour-to-hour variation throughout the day in load requirements of different classes of service and different major appliances; 2) relationships between the probable behavior of coincidence factors for a group of customers with a change in their individual load factors; and 3) relationships between energy usage and maximum demands of different groups of customers. This discussion is further confined to data on the load characteristics of three general classes of service—residential, commercial and industrial. Service rendered to other classes such as street lighting, railroads and railways, and other electric utilities is of such an individual nature as to present specialized problems, not susceptible to generalized statement.

Predicting Physical Features

The actual values used in the accompanying illustrations represent experience with the load of one electric utility system operating in metropolitan, suburban and rural territories of the Middle Atlantic States.

Perhaps there is no other engineering responsibility in an electric utility that is more important than system

planning. Moreover, in a large measure results of this work depend on the accuracy and good judgment exercised in predicting the physical features of the future load through load forecasting.

There are in use many methods of forecasting future load requirements. They range from the simple extrapolation of past trends of the overall system load, through the statistical application of the method of cyclical projections, to the analytical predictions of the behavior of individual classes comprising the total load, or of even the individual groups or elements forming them. It is beyond the scope of this article to discuss the merits and demerits of these various methods; suffice it to say that different purposes may require different methods. But for intelligent appraisal of future trends in physical features of the total load, as a result of widely changing conditions overall system load forecasts, without analytical breakdown into components, are not conducive to either a high degree of accuracy or to creation of confidence in the validity of the forecasts.*

The basis of most load forecasting, especially of the analytical nature, rests on estimates of energy requirements. However, energy alone is insufficient to define completely the requirements of electric service supply. The rate of such energy requirements over comparatively short intervals of time (such as an hour, half-hour or quarter-hour), commonly called demand, is of equal, if not greater, significance in connection with most electricity supply problems.

Knowledge of demand requirements throughout the day and throughout the year by different classes of service and by different groups within the class is not disclosed by over-all energy or load statistics. Nor do such data by themselves disclose the fundamental nature of the physical features of customers' load characteristics or of the probable relationships which exist between their various factors. A reliable knowledge of these features is essential, however, in predicting the behavior of load characteristics of the class, as well as of the system under a widely changed nature or composition of its components. To obtain this knowledge, research must be undertaken into the various phases of customers' load characteristics, either through compilation of available information or by comprehensive tests of carefully selected samples over a wide range of desired controlling features of the load studied.

To facilitate an intelligent conversion of the forecasts of energy requirements into power demands, it is desirable that such energy forecasts be split into periods shorter than a year, perhaps into calendar months, or into calendar quarters. When such details are not required, the estimates may be made for a calendar year with an indication of the requirements for a month at the end of the calendar year, which for most electric utility systems in this country, under existing conditions, ordinarily represents the month of the highest annual power demand. The accompanying illustrations therefore, are confined mainly to December conditions.

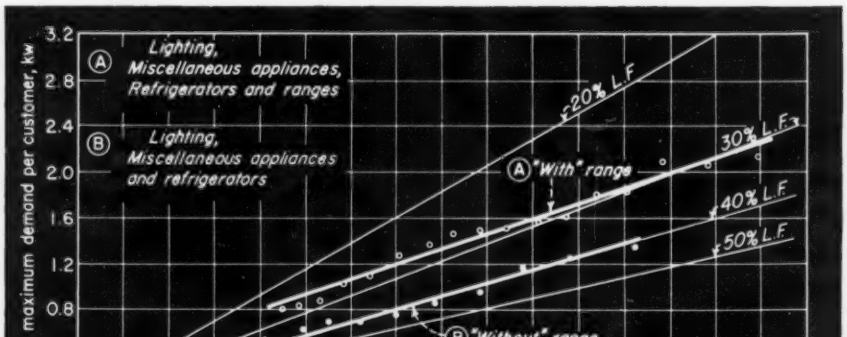
Predicting Economic Features

As well as for forecasting future system requirements in physical terms, results of load research are also indispensable in predicting the

* "Post-War Loads on Electric Systems", Constantine Bury, E W, Jan 8, 1944, pp 55-62.

ENERGY CONSUMPTION AND DIVERSIFIED DEMAND

(Based on tests made in winter period of 1946-47)



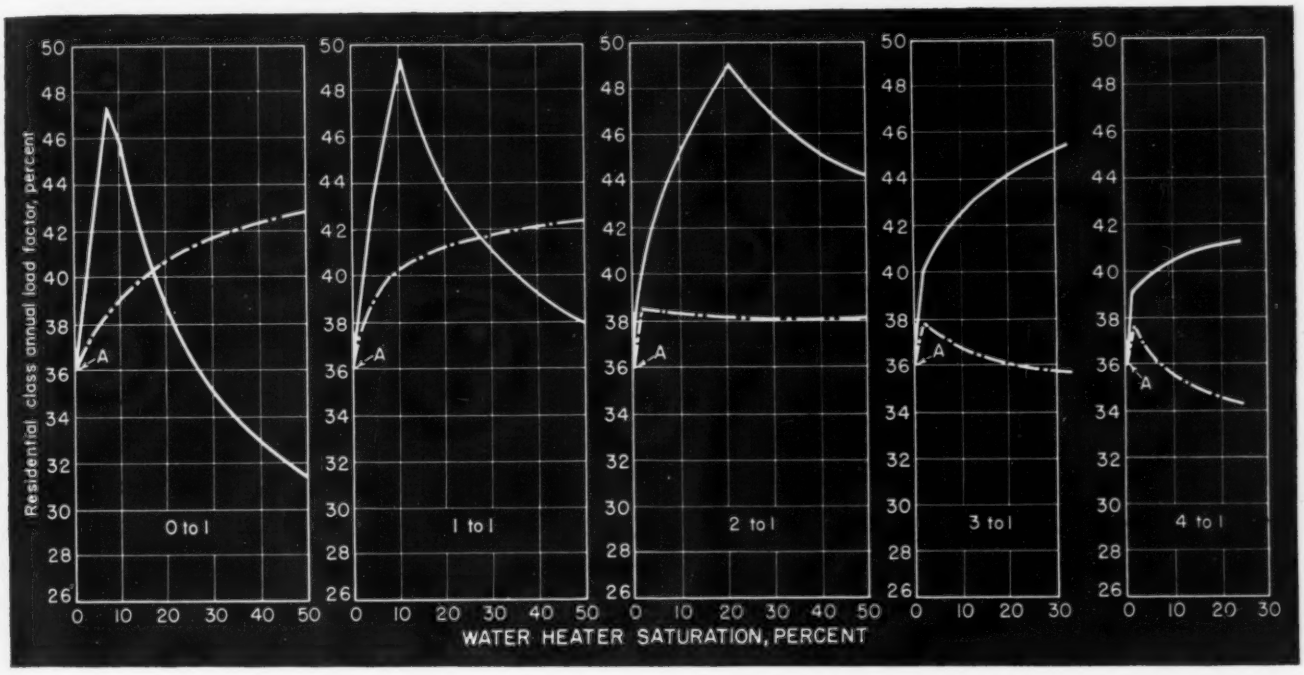
THE RELATIONSHIP depicted in this chart employs the customers' annual energy usage as the controlling feature of classification. The probable relationship shown between energy consumptions and group maximum demands for customers with and without electric ranges can be used to predict group demands per customer over a wide range of individual customer's energy usage, and points to some very important trends which are present within the residential class:

1—Without controlled, or off-peak, loads, group maximum demands increase with increase in energy usage;

2—Increase in group maximum demands of customers without electric ranges is not uniform with increase in energy usage, resulting in a general trend toward an improvement in their group load factors from the lower to the higher energy use levels. But this improvement does not continue indefinitely under existing appliance saturations. The relationship between group maximum demand and energy consumption tends to stabilize at an annual load factor of about 40% for annual uses above 3,000 kwhr per customer;

3—For a given energy usage, the group maximum demands of customers with electric ranges are about 40% to 50% higher than those of customers without electric ranges. Thus, for the same energy use, the annual group load factor of customers with electric ranges is between ⅔ to ¾ of the value for customers without electric ranges. The low load factor of the electric range, coupled with the comparatively low rate levels required by service to it, makes it a desirable load for the utility only when it is accompanied by a proper amount of controlled and completely off-peak loads.

RANGE AND WATER HEATER LOADS



APPLICATION of results of research on load characteristics of electric ranges and storage type water heaters to the characteristics of residential class load composed of present-day lighting, miscellaneous appliances and refrigerator loads, enables the prediction of how the addition of these two appliances affects the load factor of the class. The predicted features are expressed in terms of annual load factors of the class because, in an appraisal of the economic significance of any load supplied by an electric utility, this factor is of major importance. The curves show that:

1—For the improbable (but theoretically possible) condition of zero range saturation (0 to 1) the introduction of controlled water heating load (solid line curve) into the residential class of service up to saturations of about 17%, results in a higher load factor for the class than does the introduction of uncontrolled water heating (dash-dot line). Beyond this saturation value, however, the uncontrolled water heating load produces a higher class load factor than the controlled type.

2—The same condition holds for the theoretically probable, but in general yet far from attainable, condition of one-to-one range to water heater saturations (1 to 1), except that here the crossing point of the curves is at about a 28% water heater saturation.

3—For the most probable condition of two-to-one ratio of range and water heater saturations (2 to 1) and for the conditions of higher ratios, the introduction of a controlled type water heating load into the residential class, results in a considerably higher load factor of the class than the introduction of the uncontrolled type water heating load over the entire possible range of domestic water heater saturation.

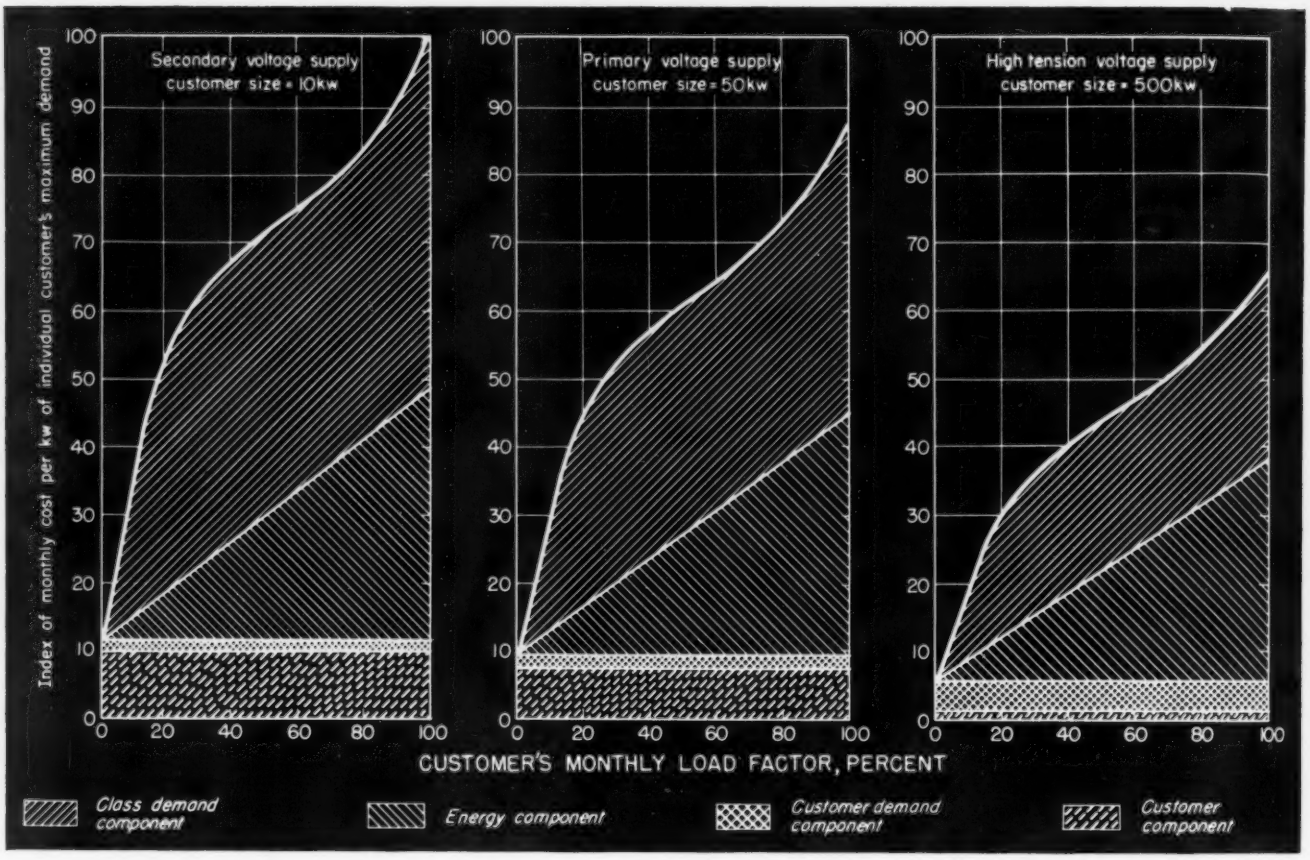
Thus, the best economic results for the utility are obtained when both ranges and water heaters constitute a part of the total residential load, when the water heaters are operated on controlled basis and when the ultimate market saturation of these appliances approximates the ratio of two ranges to one water heater.

economic features of electric service supply. That a proper evaluation of these features requires knowledge of costs, functional unit cost components, and their behavior under varying conditions is self-evident. But it is not so well realized that of equal importance is a thorough knowledge of the trends in, and the probable behavior of some of the major factors of customers' load characteristics.

No cost relationship of any significance can be obtained without knowledge either of customers' group coincidence factors, or of their diversified demands. This is because of the relatively large magnitude of the so-called "class demand" component of costs. The aim of load research in this field is to obtain relationships which would produce the most probable values of coincidence factors and diversified demands for certain known conditions of customers' loads.

It is impracticable, as well as undesirable, to establish pricing schemes reflecting each and every individual customer's contribution to the cost of rendering service. When prices cannot entirely reflect the full magnitude of absolute costs, relative prices reflecting relative cost must be resorted to. Recourse is therefore made to averaging costs in some equitable manner, and then devising a pricing scheme which will reflect them equitably. There are numerous ways of obtaining averages. Each requires a classification or sorting of individual cases on the basis of some controlling feature, be it customers' energy usages, demands, or load factors, etc. Such a classification can only be accomplished by the use of sufficient judgment and care to insure that the classification faithfully reproduces the controlling feature of the whole. Mathematical technique is no substitute for judgment. Controlling features should be selected to produce averages which would result in the minimum deviation throughout the mass of individual cases, commensurate with practical requirements.

ILLUSTRATIVE COST CURVES FOR DETERMINATION OF RATE FORMS


Secondary voltage supply
customer size = 10kw
Primary voltage supply
customer size = 50kw
High tension voltage supply
customer size = 500kw
Index of monthly cost per kw of individual customer's maximum demand
CUSTOMER'S MONTHLY LOAD FACTOR, PERCENT
Class demand component
Energy component
Customer demand component
Customer component

COINCIDENCE FACTOR vs load factor relationship is useful in the prediction of trends in cost to serve over a wide range of customer's requirements, of the commercial and industrial class, using the customer's load factor as the controlling feature. The cross-hatched areas represent the 4 fundamental cost components, and are indicated to illustrate the significance of the class demand component whose magnitude over the entire range of load factors depends so much upon the coincidence factors. To conform to these cost relationships, over the entire range of load factors, a revenue curve must be based upon a rate form which combines within itself the basic individual features of the Wright, the Hopkinson and the Doherty rate forms. Individually, none of these classic rate forms possess the inherent ability to conform fully and over the entire range of load factors and customers' maximum demands to the predicted cost curves which reflect the fundamental costs and the relationship between group coincidence factors and individual customer's load factors.

Once established, the controlling feature becomes the dominant principle upon which the determination of cost and the design of rates are based. The last three graphs in the accompanying series illuminate this idea.

This discussion has demonstrated with a number of different examples, the fact that load research aids greatly in predicting the physical and economic features of electricity supply. These examples are only a few from a vast number of cases of applications of the results of load research. Knowledge acquired through such predictions are essential for the continued progress and wellbeing of the electric utility industry.

To be of practical value, load research activities must be continuous, because the load characteristics of electric service do not remain static either for the system as a whole, for its class components or for the various groups of customers within a class, or even for the individual appliances and applications. The forces acting upon them are complex. Notwithstanding their complexity, it is known from experience that in a qualitative sense certain relationships, fundamental in character, exist between some of the factors of these characteristics. However, the dynamic nature of load behavior is apt to alter, over a period of years, the numerical values of these relationships. It is this latter condition which requires constant vigilance and continued research to detect, as early as possible, any major changes that may be taking place in the general trends of these relationships. Predictions of the features of electric service supply can be only as good as the underlying knowledge of facts. To keep them good, load research must be pursued with vigor and enthusiasm, since ignorance of facts inspires fear and stifles progress and knowledge of facts implants confidence and guides on to better accomplishments.

The author acknowledges valuable suggestions from I. L. Craig and W. W. Gilmore, Philadelphia Electric Co, and thanks to A. Abramovitz, also of that company, for assistance and suggestions in preparation of material, which was used also in a paper presented May 6 to the engineering and operation section of the Southeastern Electric Exchange.

NOW—

MAKE CABLE JOINTS

STRONG POINTS

Now, for the first time, you can obtain a splicing tape that matches the qualities of high-voltage Super Coronol cables.

It is the new Super Coronol tape—suitable for use with any rubber-type cable. And though this tape is a simple thing, it's important. Because splices are potential danger points in any cable system. And because Super Coronol tape will last longer than any other.

This tape, like the insulation on Super Coronol cables, is made of butyl-base compound, a synthetic rubber with a custom-built molecule. Remarkable stability makes possible extra long service life, and makes possible a splice as strong electrically as the cable itself.

Super Coronol tape comes in a No. 8 roll, 3/4-inch width, 22-foot length. A new Coronol cement has been developed especially for this tape. For other information and prices, ask for HB 1298, p.1. *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*

SUPER CORONOL

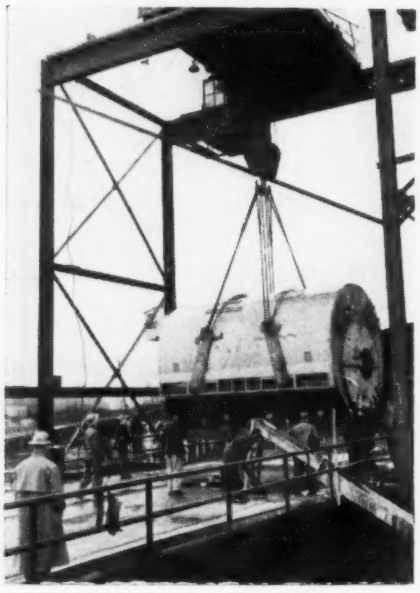
high-voltage

splicing tape and cement

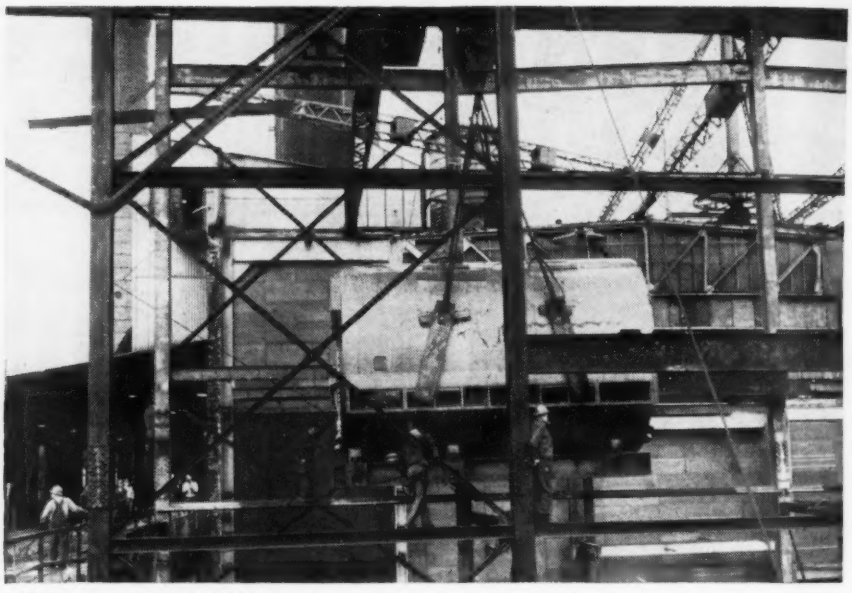
GENERAL ELECTRIC

502-77

HOW TO DESIGN • CONSTRUCT OPERATE • MAINTAIN



HUGE STATOR of the 44,000 kw unit is picked up from the railroad siding



MOVING HORIZONTALLY through the steelwork for the Gorge plant extension the stator is guided by men perched precariously on I-beams

44,000 Kw Generator Stator Takes A Ride

PICTURES SHOW the stator of the new 44,000-kw generator for the addition to Ohio Edison Company's Gorge power plant in Akron being lowered into position from a railroad siding above the plant.

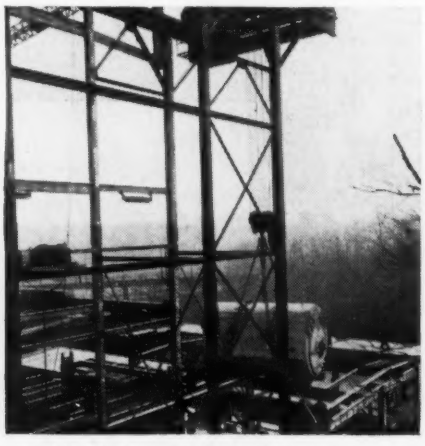
Due to the steep bank along the Cuyahoga River, on which the addition to the plant is being built, the piece of equipment shown, weighing 114 tons, had to be picked up by an overhead crane from the plant yard, moved out a distance of 100 ft over the building structure, then lowered 70 ft into the turbine room through an opening left in the steel framework of the roof.

All other turbine room equipment, including the turbine which will be moved by sections and then assembled, will be lowered to a dock outside the building and skidded into position. The stator is the heaviest and largest piece of equipment that will go into the plant, and is the only unit that used the roof entry.

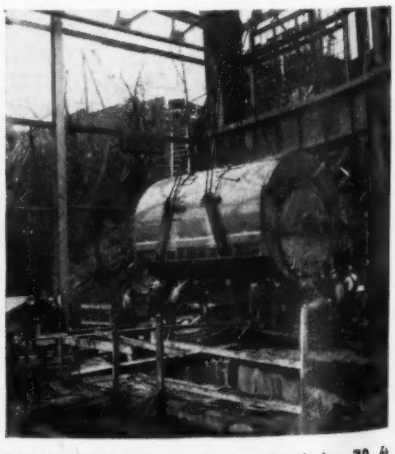
Steel for the addition that will house the turbine and generator is already in place, and brickwork and roofing are now under way. The new unit is expected to be in operation late this fall.

(Pictures Courtesy Ohio Edison Co)

STARTING DOWN after being moved 100 ft over the building structure the stator is about to be turned to pass roof gap



THREADING THE NEEDLE with the rotor as it slid through the opening in the roof was a ticklish operation



DOWN EASY at the end of its 70 ft vertical travel. Workmen ease the machine onto its temporary foundation

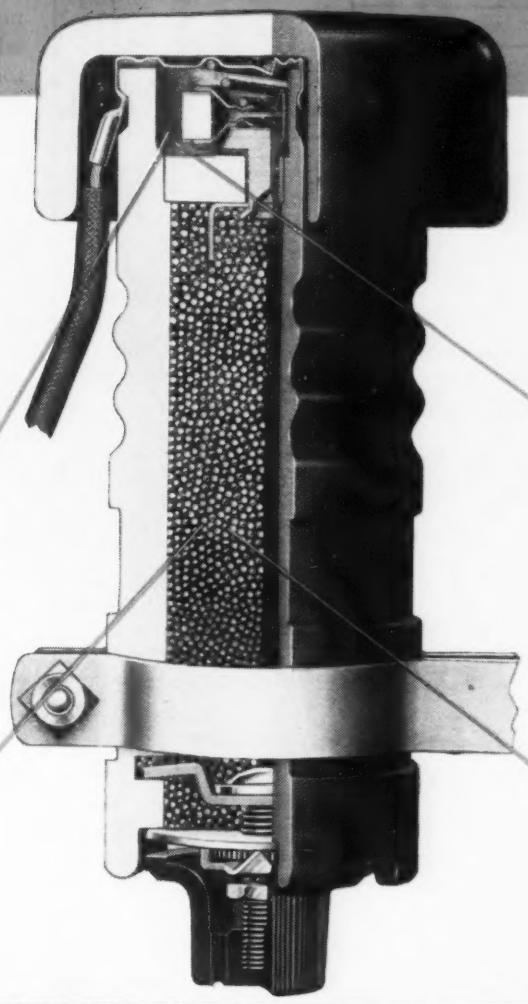
Get that extra protection

SPECIFY G-E PELLET ARRESTERS

For extra protection for your Distribution Transformers

Low initial sparkover voltage to start discharge. The impulse sparkover voltage of a 3-kv pellet arrester, for example, is *less than one third* of the AIEE impulse test level, and even *well below the crest value of the 60-cycle one-minute standard test* of 2400-volt transformers.

Exceptionally low IR drop during discharge. The efficiency of the G-E pellet type valve-element is tops — it provides valve action and holds lightning voltage stresses to exclusively low levels—while protecting against low, medium, or high lightning currents.

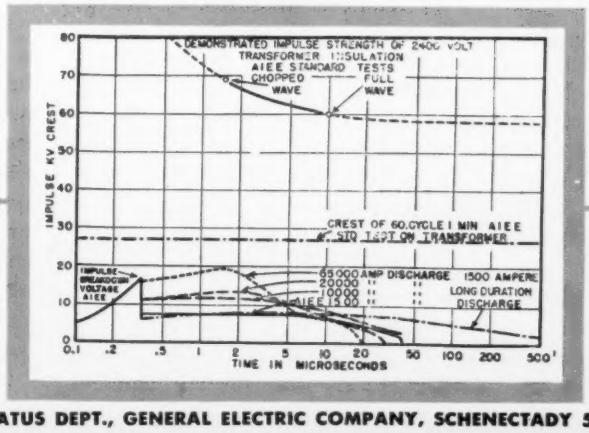


For extra protection for the Arrester itself

Dry Nitrogen is sealed into the gap chamber of all G-E pellet arresters — an *exclusive G-E feature*. This dry, inert gas prevents formation of ozones or oxides — keeps the gap electrodes bright as new during years of service operation.

Pellets, themselves, are of dioxide of lead — *a distinctive valve material whose characteristics are unaffected by moisture*. Therefore, the pellet valve-element is self-protecting against service moisture, condensation or humidity — another reason for pellet arrester reliability.

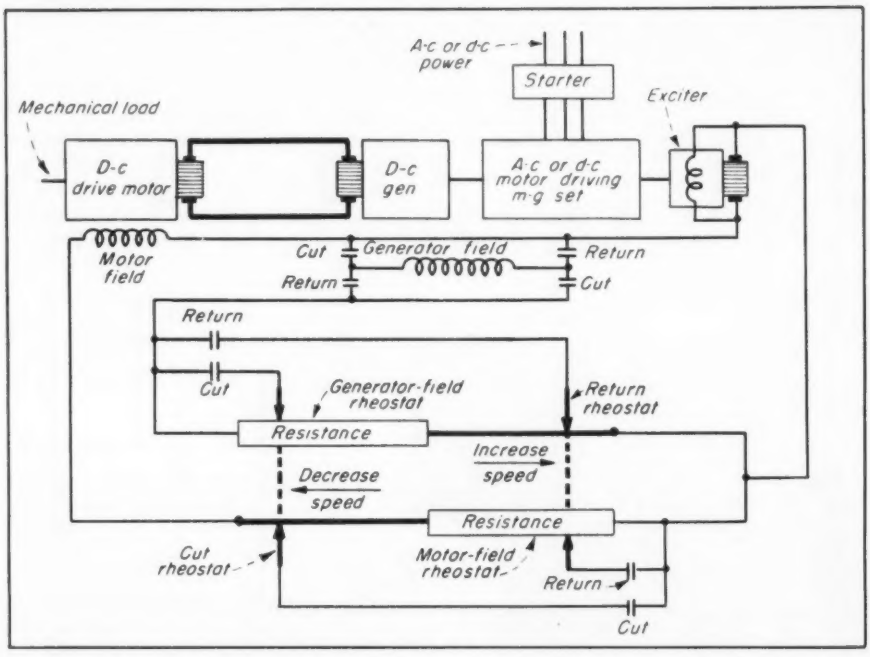
Extra overall protection. This curve was made from actual volt-time and ampere-time cathode-ray oscillograms of a 3-kv G-E pellet arrester. Even at 65,000 amperes discharge current, the maximum voltage stress on the transformer is *but a fraction of* the impulse test level of modern 2400-volt transformers and assures a *wide margin of protection to even very old transformers.*


DEMONSTRATED IMPULSE STRENGTH OF 2400 VOLT TRANSFORMER INSULATION
AIEE STANDARD TESTS
CHOPPED WAVE
FULL WAVE
CREST OF 60 CYCLE 1 MIN AIEE STD TEST ON TRANSFORMER
IMPULSE BREAKDOWN VOLTAGE AIEE
65,000 AMP DISCHARGE 1500 AMPERE
20000 " " LONG DURATION
10000 " " DISCHARGE
AIEE 1500
IMPULSE KV CREST
TIME IN MICROSECONDS

The G-E pellet arrester *will handle severe lightning stroke discharge currents*—all ratings will readily withstand the AIEE and NEMA standard 65,000-ampere test. And — typical cathode-ray oscillograms obtained on G-E pellet arresters of various ratings, after 6 to 19 years of service where subject to frequent and severe discharges, prove that *pellet arresters retain unexcelled protective characteristics.*

APPARATUS DEPT., GENERAL ELECTRIC COMPANY, SCHENECTADY 5, N. Y.

GENERAL ELECTRIC



PLANER CONTROL CIRCUIT is relatively simple because of the operating characteristics that are designed into the rotating machines

Applying Motors And Control For Wide-Speed Range

J. W. HARPER*
General Electric Co
Schenectady, N. Y.

TODAY'S ELECTRIFIED planer drives have a 30 to 1 speed range; but because of better cutting tools there is a tendency to cut this down to 15 or 20 to 1. This would mean limiting the bottom speed to 80 to 100 rpm instead of 40. The top speed would be the same or possibly a little higher. Also this would eliminate motor field weakening and its attendant loss of accelerating torque, so such drives should be even snappier over the entire range.

Drives for small planers follow this pattern, but with more limited speed range. Drives for large machines also have been built using voltage control over a wider range. But such drives do minimize lost time in acceleration and deceleration. Since this is non productive time, anything to reduce it is advantageous.

Improvements in future planer drives are likely to be in refinements, rather than in any major electrical design changes. As cutting tools improve, drives have increased horsepower with possible modification of present drives to permit operation further up on the constant torque curve. Some packaged drives have been applied. A way of putting the speed control in the pendant station would be a worthwhile improvement. This would eliminate one control unit and its mounting, and also provide a more flexible controlling means.

Present planer drives cost anywhere from 15 to 80% more than drives formerly used. The drive alone should not be considered, but the overall combination of planer and drive. Thus an overall increase of 10% by using an adjustable voltage drive may step-up production 15 to 20%. The best drive can be selected only when based on all the factors involved such as setup time, and long or short strokes.

An ideal planer drive includes: wide speed range, ample torque capacity, simple control, safety, and reliability.

Motors and Generators Matched

A modern planer drive consists of seven basic parts: planer motor, motor-generator set, its starter, main controller, rheostat for cut and return speed adjustment, limit switch and pendant push-button station. These components must be designed to function as a unit to get the most production out of the planer.

Motors are designed with low inertia for fast acceleration. They use blowers for ventilation at low speeds. Ball bearings are used for minimum maintenance and assured lubrication.

Motor-generator sets require the minimum of floor space, being close coupled and having only two ball bearings. Standard stators are used to simplify replacements. All units are protected from falling foreign matter. For severe conditions, totally enclosed fan-cooled driving motors and filters are used for the generator and exciter.

Generator Characteristics

The generator's characteristics match closely those of the planer motor. Thus maximum flux response is obtained. Field constants are so proportioned that change of field current controls acceleration and retardation of the planer motor. For example, from high speed forward to high speed reverse, full field is applied to the motor and the generator field is discharged in one step. When the generator voltage decays to 25 to 30% of maximum, the generator field is energized for opposite rotation. When the voltage increases to about 35% in the opposite direction, the motor field weakening relay opens, inserting the motor field rheostat. No objectionable sparking occurs at the commutators of the unit. Under these conditions the reversal time from 1,200 rpm to 1,200 rpm is about 1.25 sec.

Compound windings insure good regulation over a wide range of generator voltage. For special requirements at very low cutting speeds, drives require auxiliary exciters.

Relatively, the control is simple, as shown in the schematic. This is the result of designing all rotating machines to possess inherently the necessary operating characteristics with as little aid as possible from the control. This results in a panel with seven operating devices; only six of which operate on the normal reversing cycle. On these devices only 21 contacts open or close during the cycle.

Over-all speed of response is a maximum. This is because the generator shunt field circuit is free of all shunting resistors, which would slow up flux changes by damping action.

Quick stopping is obtained by

* Adapted from Conference Paper "Planer Drives—Their History and Application", presented at 1948 AIEE General Meeting

lamp-matched ballasts

All the power for a fluorescent lamp goes through the ballast. If the lamp is to deliver its full rated life and full light output, the ballast must be not "just a transformer," but an accurately made piece of equipment, with permanent electrical characteristics tailored to the voltage and current requirements of the lamp under both starting and running conditions.

General Electric, maker of lamps, ballasts, starters, cable and lampholders, is well aware of this interdependence. General Electric ballasts are designed, built, *and tested* for permanent, matched characteristics.

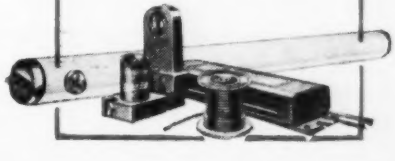
Losing Lumens?

The ballast can be the determining factor in the light output of your fixtures—G-E ballasts deliver all the light your buyers expect—every lumen of light the lamp is designed to give!

General Electric fluorescent ballasts are lamp-matched—engineered, manufactured, and tested to assure you full rated lamp light—for full rated lamp life—from all standard fluorescent lamps. Write today for bulletin GEA-4950.

Apparatus Department, General Electric Company, Schenectady 5, N. Y.

BALLASTS
CABLE
LAMPS
STARTERS
LAMPHOLDERS
for
DEPENDABILITY
in fluorescent lighting



GENERAL ELECTRIC

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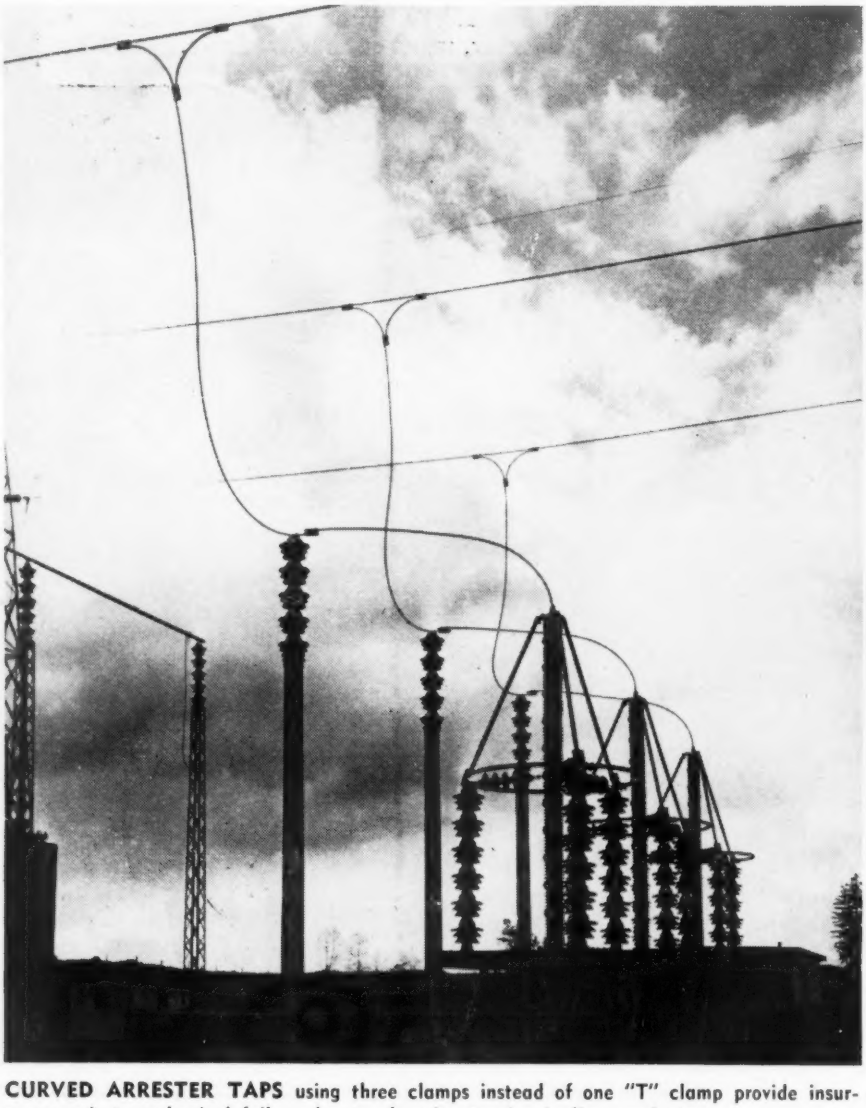
combining a time delay function with the field rheostat selecting relays. Thus the generator field is energized only momentarily in the opposite direction to bring it to a minimum value in the shortest possible time. Also, both for reversing and stopping, the control connects the generator field into a discharge circuit. This circuit is automatically adjusted to compensate for the previous setting of the field rheostat.

For quick stopping on voltage failure, a low voltage relay, (also used to select between automatic and inch operation) releases when the control voltage from the exciter drops to about 75% of normal. Hence, if the set starts to slow down because of a-c power failure, the low voltage contactor drops out. This stops the planer motor while there is still enough exciter voltage left to operate the relays and supply field excitation.

The main controller and the rheostats are built in identical floor-mounted cabinets, so they can be mounted side by side or separately, depending on space available.

Properly applied limit switches successfully withstand the hammer blows of high speed planer operation. To minimize wear, moving parts are as light as practicable and thus reduce inertia forces.

Curved Taps Insure Against Mechanical Failure



CURVED ARRESTER TAPS using three clamps instead of one "T" clamp provide insurance against mechanical failure due to changing tension in line conductors

THE BEAUTIFULLY CURVED taps to lightning arresters shown here were not made to provide an easy path for high-frequency, steep wave front charges, as might be suspected. Rather, the practice is used by the Bonneville Power Administration purely from a mechanical standpoint. As against a single "T" tap, it is felt better to spend a few cents more and use two additional clamps. That way there is less danger of lightning arrester taps being pulled out of clamps with changing stress in the line conductors due to temperature changes.

Installation shown is at new Snohomish substation of BPA near Everett, Wash. Station has a single transformer bank with capacity of 250,000 kva, 230/110 kv, said to be the largest transformer that has ever been built.

GROUNDING and protective concrete junction box used at base of cable riser poles where raceway changes to iron conduit

Concrete Pullbox Links Transite To Conduit

FOR ELECTRICAL and mechanical transition from Transite to rigid iron conduit at its unit distribution substations, a western utility uses the type of installation shown. Transite ducts from station to base of riser pole terminate in the concrete box extending above ground. A metal housing on top provides weatherproofing and has welded-in nipples for the conduit risers. Conduit and cable sheaths are grounded below the potheads at the top of the pole and again at the base. Cable sheaths are then again grounded at the substation end. In this way any sheath currents or stray curents are prevented and the whole 4-kv takeoff system is effectively grounded.

DISCONNECTING-SWITCHES

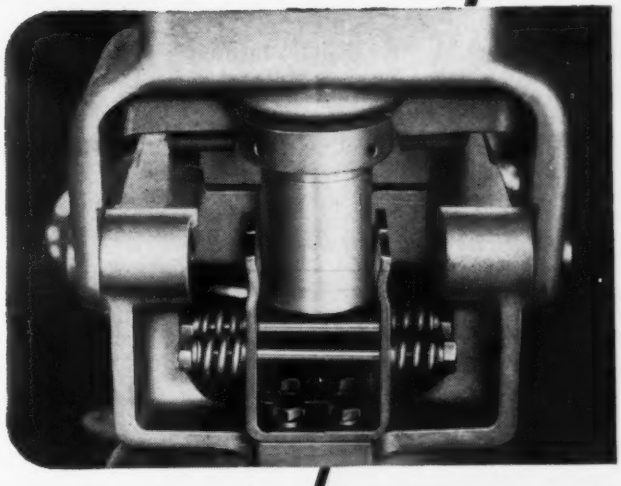
WITH SILVER-TO-SILVER LINE PRESSURE CONTACTS

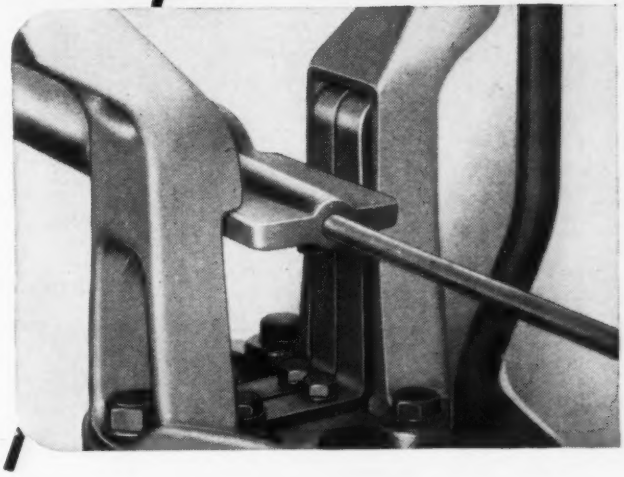
NO CURRENT-CARRYING BRAIDS as silver-to-silver contacts are used for *all* current-carrying duties. At the hinged end the silver surface of the movable blade contacts the silver surface of a U-shaped clip. Adjustable, stainless steel compression springs back the clip. This feature on the RF assures a positive contact at *all* times and eliminates *any* burning of the switch.

NEW OPERATING MECHANISM has no cams, is of simplified construction. Anti-friction bearings are used on all main moving parts . . . "Dual Operation" feature rotates the blade as it enters the stationary contacts. This action firmly forces the blade against the contacts under all weather conditions. The turning motion also locks the blade against the lip of the contact housing . . . Over-travel of the rotating insulator stack is possible without causing any additional rotation of the blade. This feature eliminates any critical adjustment of the operating mechanism . . . and no critical adjustment is necessary after the switch is installed as the three poles of the switch are easy to mount and line up.

CONTROLLED CONTACT PRESSURE eliminates unnecessary scoring and excessive wear on the silver contact surfaces . . . The stationary contact consists of U-shaped copper fingers backed by individual non-current carrying stainless steel springs . . . And remember—silver-to-silver line-pressure contacts are used throughout on the new RF braidless disconnecting switch.

See your nearest G-E sales representative about the new RF disconnect. Write for bulletin GEA-4980. *Apparatus Department, General Electric Company, Schenectady 5, New York.*





GENERAL ELECTRIC

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Runner Size of Hydraulic Turbine

FOR impulse single-jet turbine, Francis turbine and propeller turbine, the accompanying chart gives capacity factor (K) in relation to specific speed (n_s).

Valve of K is then used to determine the runner size by the following formula

$$D = \sqrt{\frac{Q}{K\sqrt{H}}}$$

where:

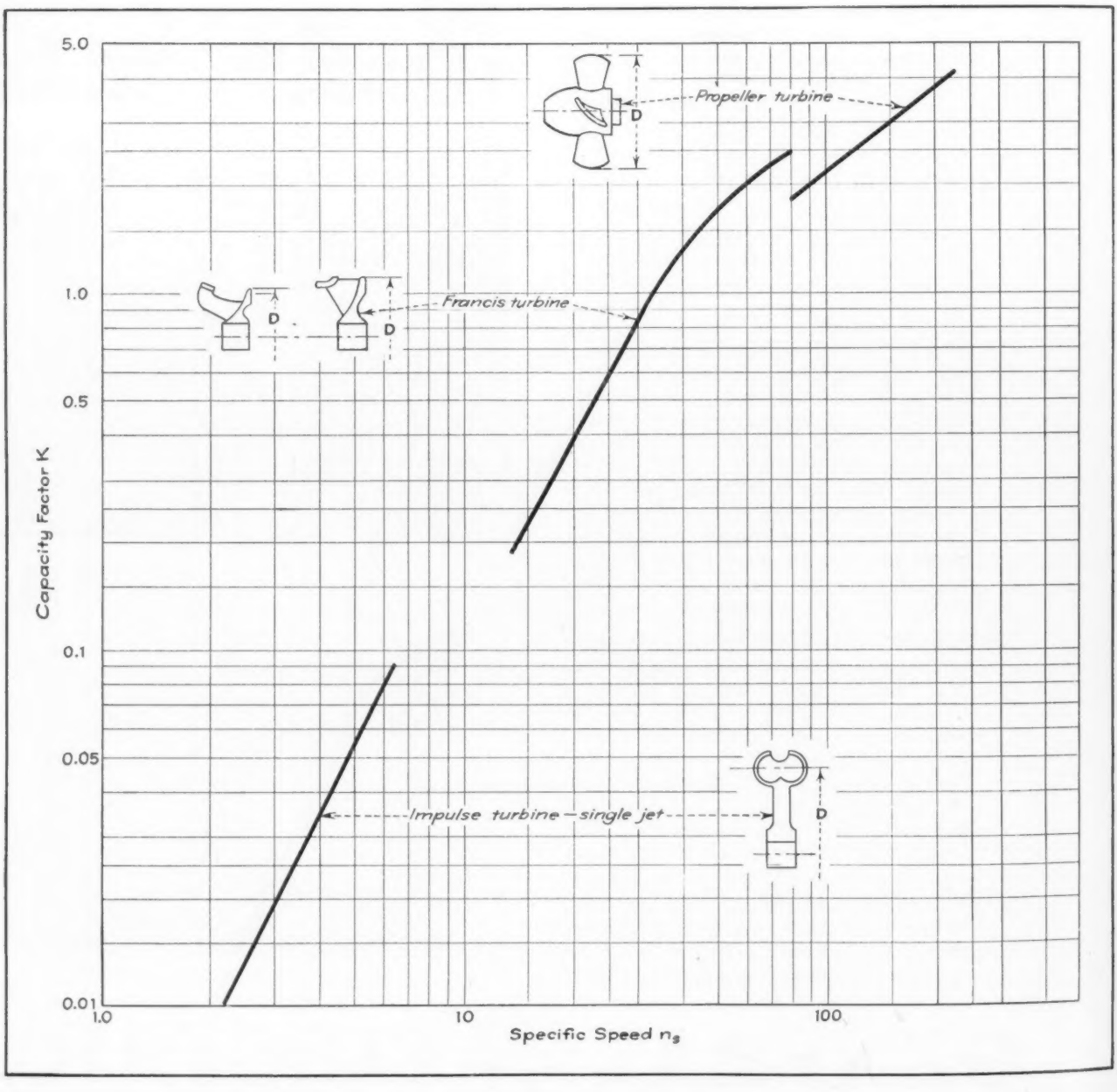
D = diameter of runner in feet

Q = capacity in cubic feet per second

H = effective head in feet

K = capacity factor

Chart (in original metric form) by Quantz (Escher Wyss, 1943); converted from metric to English system of measurement by H. W. Hamm, Design Engineer, S. Morgan Smith Co, York, Pa. It is suitable for any diameter in the range of specific speeds for respective turbine type.



SEE REVERE

FOR CONDENSER TUBES AND PLATES

EXPERIENCE has proved that in a majority of installations Revere Admiralty Metal condenser tubes, inhibited to resist dezincification, will give long, satisfactory and economical service. However, Revere also makes tubes in Cupro-Nickel, Revalon (aluminum brass), Red Brass, Muntz Metal, Arsenical Copper, and Copper, thus enabling you to select the Revere Metal or Alloy best suited to meet your operating conditions.

In addition, Revere manufactures pipe and tube in copper and brass for general piping purposes, and electric welded steel tube.

Revere condenser plates can be had in a number of alloys in squares, rectangles, circles, half-circles, segments, and special patterns, up to 120 inches maximum dimension, finished weight about 11,000 lbs. maximum. These plates are flat, dense, free from blow holes or other imperfections, accurate in gauge, and are easily machinable.

As each condenser, heat exchanger or other piece of equipment using tubes and plates presents an individual combination of conditions, no blanket recommendations are possible. Among the factors to be considered are: chemical and impingement attack, velocities, pressures, temperatures, air entrainment, suspended solids. Should short tube life or other circumstances lead you to question your present practices, the Revere Technical Advisory Service will gladly cooperate with you in making thorough field and laboratory studies, to assist you to determine the most serviceable and economical alloys.

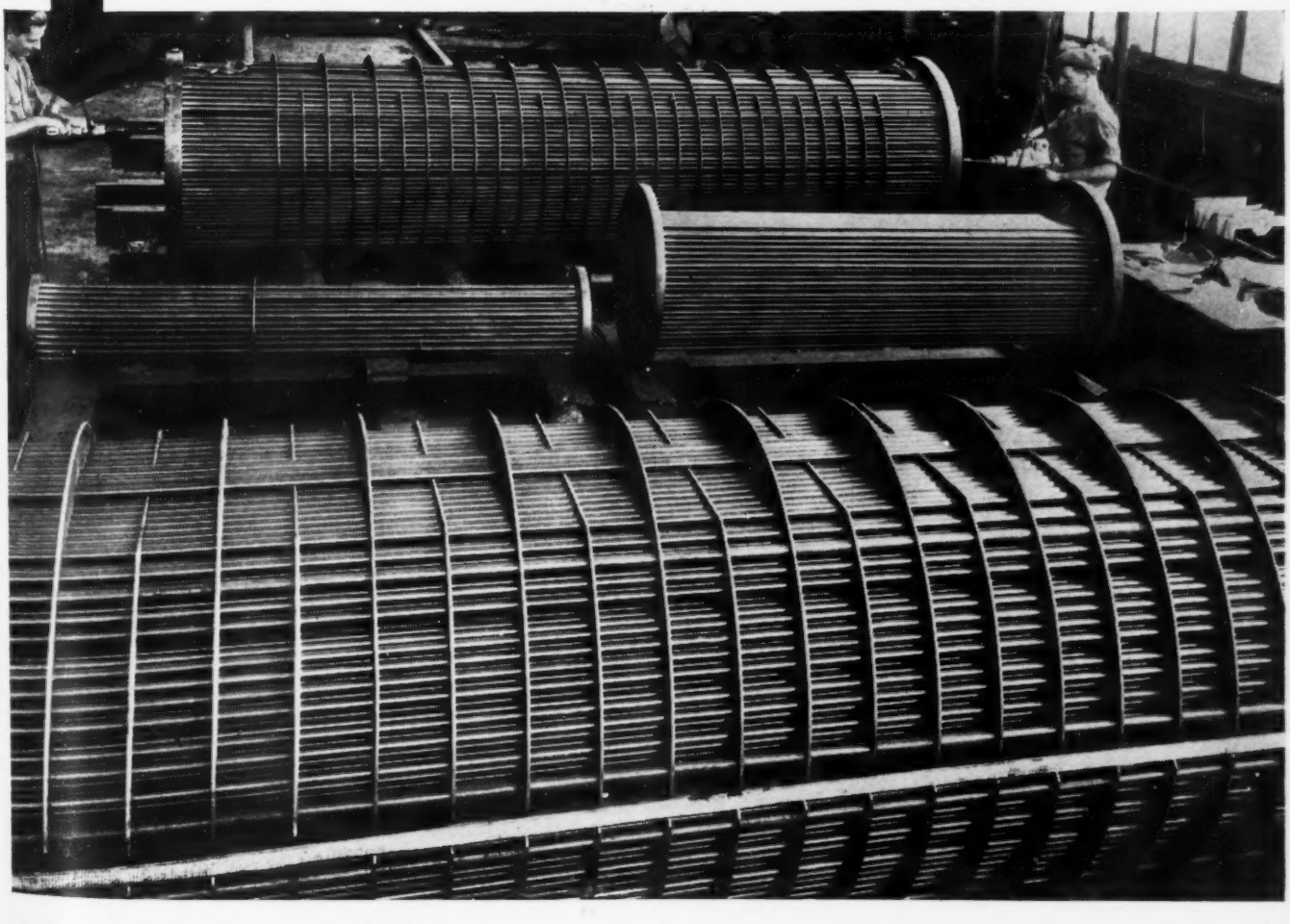
REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, New York

Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; New Bedford, Mass.; Rome, N. Y. — Sales Offices in Principal Cities, Distributors Everywhere.



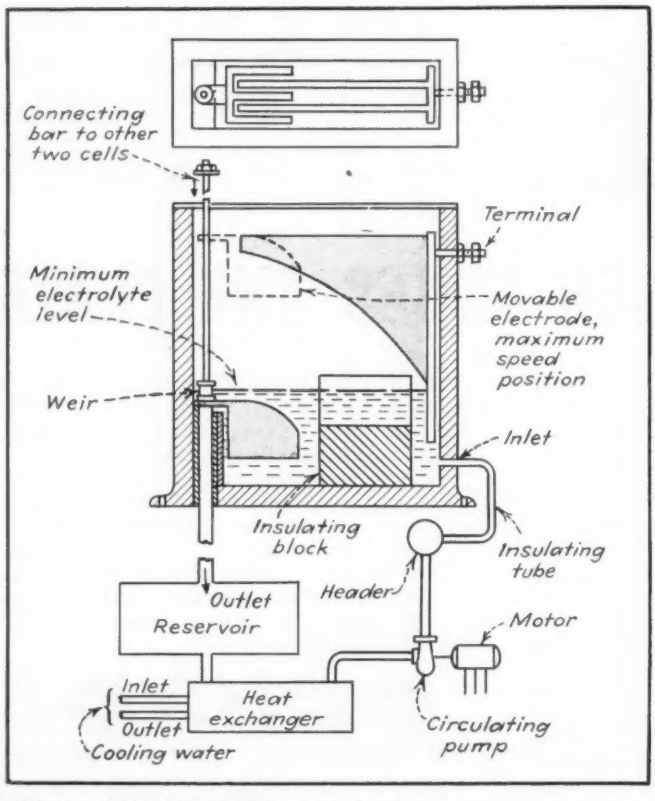


FIG 1—**MOVABLE WEIR** adjusts height of electrolyte in newly designed liquid rheostat

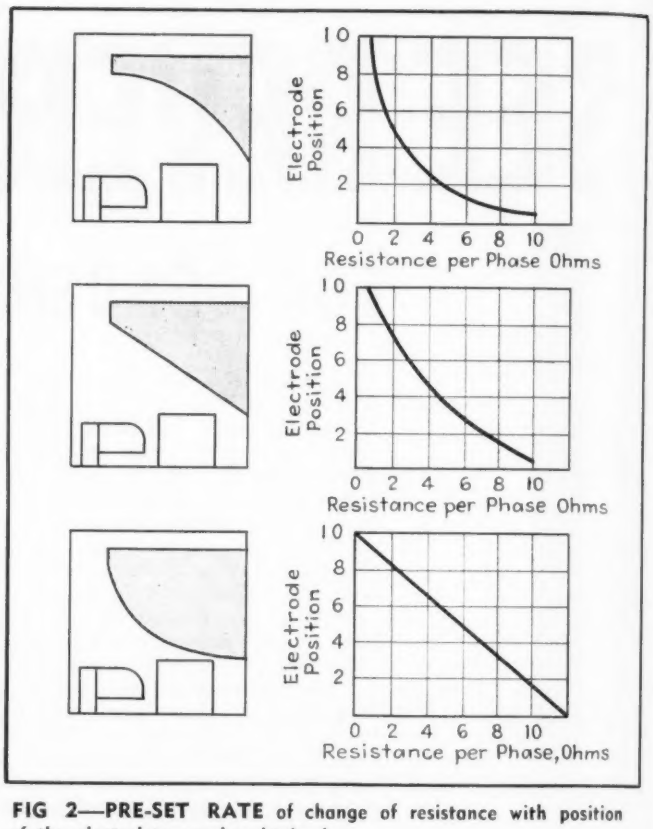


FIG 2—**PRE-SET RATE** of change of resistance with position of the electrolyte can be obtained

Contact Liquid Rheostat Uses Stationary Electrodes

T. B. MONTGOMERY
and
A. C. HALTER
Allis Chalmers Mfg Co
Milwaukee, Wis.

A NEWLY DEVISED liquid rheostat, described at the 1948 AIEE General Meeting, regulates the length and area of the current path between electrodes by changing the level of the electrolyte. This gives a wide range of resistance in small space. Also, by proper design of the stationary electrode and insulating block, almost any kind of "resistance" versus "position" curve can easily be obtained.

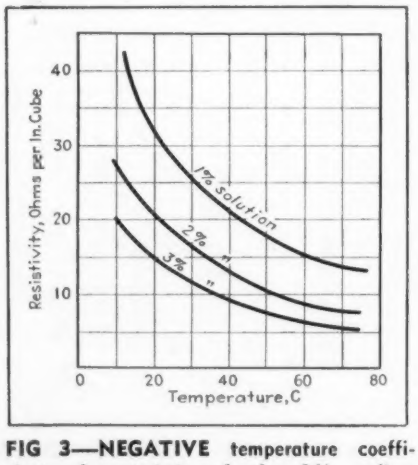


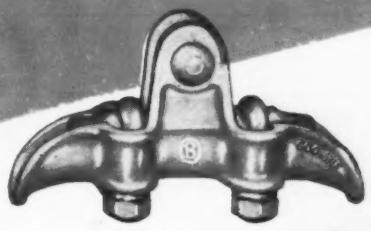
FIG 3—**NEGATIVE** temperature coefficient characteristic of the 3% sodium carbonate solution.

The container or cell of insulating material is long and narrow, as shown in Fig 1. On one end is the stationary electrode. This electrode extends almost the full length of the container at the top and slopes back to the supporting end near the bottom. At the other end of the cell is a movable weir to which is fastened a smaller electrode slightly below the level of the weir. Mounted on the bottom of the cell between the two electrodes is an insulating block. Three such cells are mounted side by side with their weirs connected to a common lifting mechanism. This connection also serves as an electrical connector between the three movable electrodes, forming the neutral. The electrolyte inlets are connected to a common header by means of insulating tubes. A reservoir, heat exchanger, circulating pump and lifting mechanism for the weirs complete the unit.

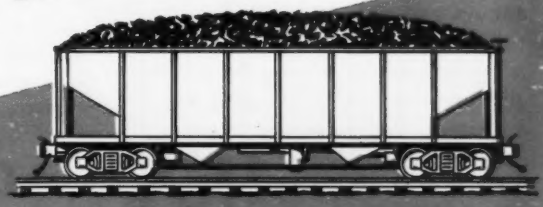
In operation, the electrolyte enters the cell through the insulating tube. After it has filled the cell to the level of the weir, it passes through the outlet pipe into the reservoir directly beneath the cell. From the reservoir the liquid passes into a heat exchanger, through the pump, and back into the header to repeat the cycle. With the weir in its lowest position, the length of the current path through the electrolyte is the longest, giving maximum resistance. When the weir is raised the liquid level rises, keeping the neutral electrode covered. Thus the length of the conducting path is gradually decreased, until the electrodes intermesh at the upper limit giving minimum resistance.

This unit is well suited to applications requiring a large range of resistance. Also, equal steps of the controlled variable for equal steps of rheostat position can be obtained as shown in Fig 2. Size is small, considering the extreme ranges of resistance obtained and the amount of heat it can dissipate. A liquid slip regulator giving 80% speed reduction on a 350 hp fan drive, is 67 in. high, requires floor space 26 x 36 in.

The electrolyte used is approximately a 3% solution of sodium carbonate in clean water. As shown in Fig 3, the solution has a negative temperature coefficient over its op-



Every O-B COOLINE CLAMP Can Save You A CAR of COAL in 25 YEARS



This conservation measure has an approximate cash value of *$285.00

HERE ARE THE FIGURES

Current per phase (from an actual case report)	480 amperes
Loss *per clamp*, 70 watts or	.07 kw
At a 50 per cent load factor, this is a yearly loss of	3045 kwhr
Coal at *1.3 lbs. per kwhr to supply above loss equals	1.98 tons
In 25 years of operation of this line, this totals	49.5 tons
Or, putting it another way, one Cooline clamp in 25 years will save	1 car of coal
The cost of this clamp over its ferrous equivalent is	1 dollar

* Fuel efficiency and costs taken from published national statistics.

By eliminating the heat-loss effect on transmission line hardware through the use of non-magnetic aluminum alloys, O-B Cooline clamps can often produce major savings. Such savings have been interpreted here in terms of bare fuel leaving out all associated costs of handling. These clamps likewise show economies in operating costs, better utilization of invested capital, and possibilities of delivering more saleable power to the meter.

It will pay you to investigate the possibilities of O-B Cooline hardware in relation to your specific operation. We will gladly supply you handy data for basing your figures. And, in adding up the advantages of this new hardware, include good delivery.

Ohio Brass

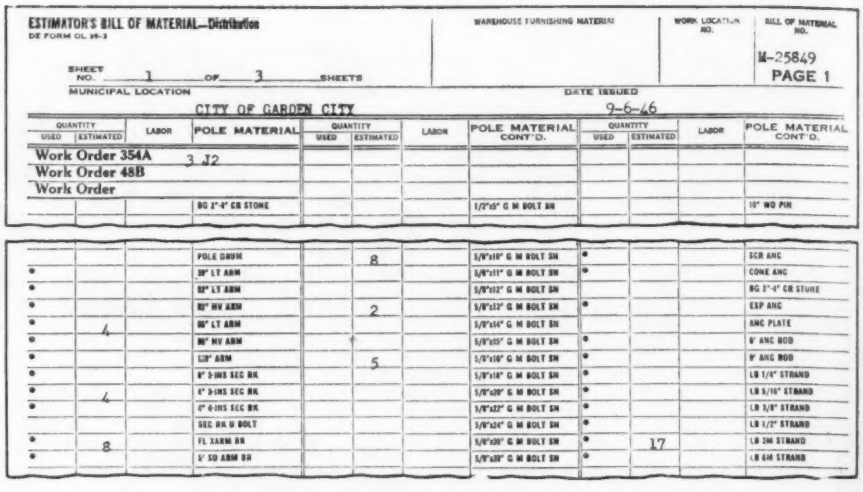
2879-H MANSFIELD, OHIO

CANADIAN OHIO BRASS CO., LTD., NIAGARA FALLS, ONT.

suitable on small drives that require stepless and precise control. Such applications include induced and forced draft fan drives, centrifugal pumps, and blower compressor drives.

They are also well suited for large flywheel set motor drives, since they produce a cushioning effect for good load regulation. Another application is for a large variable speed drive in which the load at any given speed is fairly constant, and where a high degree of accuracy is required in speed output. This is because the rheostat is stepless and can handle large amounts of power.

The type of control element used is determined largely by the accuracy and response required, and can be operated either manually or automatically. Manual control is used where a small drift is not objectionable and where accurate settings are not required. Automatic control may be obtained with air or oil operated cylinders or a pilot motor under Regulex control. This type of control gives variable response, and eliminates drift due to temperature changes. But the rate of acceleration is limited by the capacity to the electrolyte pump. Such control is used to regulate speed or current. Where extreme accuracy is required, as in wind tunnel drives, the liquid slip regulator is used in conjunction with a Regulex generator responding to an electronic amplifier. This provides an excellent combination.



ESTIMATOR'S BILL OF MATERIAL—Distribution
DE FORM OL 25-3
WAREHOUSE FURNISHING MATERIAL | WORK LOCATION NO. | BILL OF MATERIAL NO. M-25849 PAGE 1
SHEET NO. 1 OF 3 SHEETS
MUNICIPAL LOCATION: CITY OF GARDEN CITY
DATE ISSUED: 9-6-46

QUANTITY USED	QUANTITY ESTIMATED	LABOR	POLE MATERIAL	QUANTITY USED	QUANTITY ESTIMATED	LABOR	POLE MATERIAL CONT'D.	QUANTITY USED	QUANTITY ESTIMATED	LABOR	POLE MATERIAL CONT'D.
Work Order 354A			3 J2								
Work Order 48B											
Work Order											
			BG 2'-4" CR STONE				1/2"x5" G M BOLT SH				1" WD PIN
			POLE OHUM		8		5/8"x10" G M BOLT SH	•			SCR ANC
•			28' LT ARM				5/8"x11" G M BOLT SH	•			CONE ANC
•			32' LT ARM				5/8"x12" G M BOLT SH				BG 2'-4" CR STONE
•			32' HV ARM		2		5/8"x13" G M BOLT SH	•			EXP ANC
•	4		36' LT ARM				5/8"x14" G M BOLT SH				ANC PLATE
•			36' HV ARM				5/8"x15" G M BOLT SH	•			8' ANC ROD
•			L20' ARM		5		5/8"x16" G M BOLT SH	•			9' ANC ROD
•			8" 3-INS SEC BK				5/8"x18" G M BOLT SH	•			LB 1/4" STRAND
•	4		6" 3-INS SEC BK				5/8"x20" G M BOLT SH	•			LB 5/16" STRAND
•			4" 3-INS SEC BK				5/8"x22" G M BOLT SH	•			LB 3/8" STRAND
			SEC BK U BOLT				5/8"x24" G M BOLT SH	•			LB 1/2" STRAND
•	8		FL XARM BR				5/8"x28" G M BOLT SH	•	17		LB 3M STRAND
•			5' SD ARM BR				5/8"x28" G M BOLT SH	•			LB 6M STRAND

FIG. 1—ESTIMATOR'S BILL of Material forms which become final lists for all records. Form shown at top includes cost. Form shown at bottom is for pole material; poles and conductor material listed on separate pages

O. H. Line Estimating—I* Material Unit Basis

THEODORE H. GUCK
Overhead Lines Dept
The Detroit Edison Co
Detroit, Mich.

FIELD AND INDIVIDUAL job record work are reduced to a minimum in the material unit estimating method which has been used for several years by The Detroit Edison Co on its overhead lines. The field layout is summarized on printed form sheets, requiring only the estimated number of units of each standard material item. A section of the estimator's bill of material for distribution is illustrated in Fig 1. Similar forms with items to suit are used for transmission and street lighting.

The field estimator enters the number of units described by the unit numbers, and completes his layout with a sketch of the job for use by the line crew foreman.

Estimates are completed by an office clerk, inserting current values for major material items and unit cost figures for other parts of the work estimates. The bill of material for line crew and warehouse use is completed as a part of this same procedure.

* Beginning a series of four articles. Illustrations numbered in sequence throughout the series

Table Of Nuclear Energy Equivalents

	Electron Volts	Mev	Ergs	Joules, Watt-Sec.	Watt-hours	Kwhr
Electron Volts	1	10^{-6}	1.602×10^{-12}	1.602×10^{-19}	4.45×10^{-23}	4.45×10^{-26}
Mev	10^{6}	1	1.602×10^{-6}	1.602×10^{-13}	4.45×10^{-17}	4.45×10^{-20}
Ergs	6.24×10^{11}	6.24×10^{5}	1	10^{-7}	2.78×10^{-11}	2.78×10^{-14}
Joules, Watt-Sec	6.24×10^{18}	6.24×10^{12}	10^{7}	1	2.78×10^{-4}	2.78×10^{-7}
Watt-hours	2.25×10^{22}	2.25×10^{16}	3.60×10^{10}	3.60×10^{3}	1	10^{-3}
Kwhrs	2.25×10^{25}	2.25×10^{19}	3.60×10^{13}	3.60×10^{6}	10^{3}	1

Atomic Energy Conversion Factors

I. ROTKIN
Hyattsville,
Maryland

THE TERM ELECTRON-VOLT is often used in connection with nuclear fission. It signifies that the energy release is in terms of a unit based on the work done to bring an electron in from infinity against a 1-v field. To mean much to the engineer, the energy available from fission needs to be expressed in terms of ergs and then in terms of kilowatthours. This has been done in the accompanying table.

It is of further use to know the energy equivalent of the matter converted by nuclear fission. This energy equivalent can be calculated by Einstein's energy-mass equation

$$E = mc^2$$

from which the ergs per gram amount to $(2.99776 \times 10^{10})^2$ or

$E = 8.99 \times 10^{20}$ ergs per gram
$= 2.50 \times 10^{7}$ kwhr per gram
$= 2.50 \times 10^{10}$ kwhr per kg
$= 1.132 \times 10^{10}$ kwhr per lb

In all fission reactions, only a small part of the matter is converted.

BOTH • • •

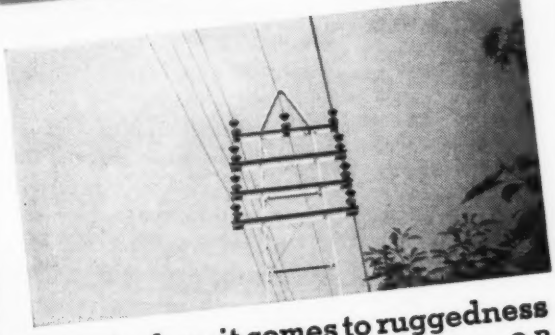
PROVED and IMPROVED

This insulator has a "name" worth remembering--O-B 38 222, nominally rated at 23 kv. It will be to your advantage to make sure it appears on your Purchasing Standards.

O-B Number 38 222

Your power customers cook, wash, and in many other ways live electrically, and they don't suffer in silence when there is a power interruption. The behavior of distribution circuits, on which those people depend, is a matter of good public relations.

Thanks to modern steep-wave impulse testing, O-B research men have discovered why some pintypes were superior to others in their ability to withstand lightning discharges. From such findings have come design revisions in certain cases, that have resulted in high lightning-resistance becoming an integral part of every O-B pintype, regardless of size. Both *proved* and *improved,* you can install O-B pintypes on your distribution lines and then forget them--until you want some more good insulators.



--and when it comes to ruggedness

These three 24-kv circuits were built on O-B pintypes in 1919, almost 30 years ago, and still supply power to the industrial section of an important mid-western city.

Ohio Brass

MANSFIELD, OHIO

Canadian Ohio Brass Co., Ltd., Niagara Falls, Ontario

Precast Concrete Manholes Speed Installation Time

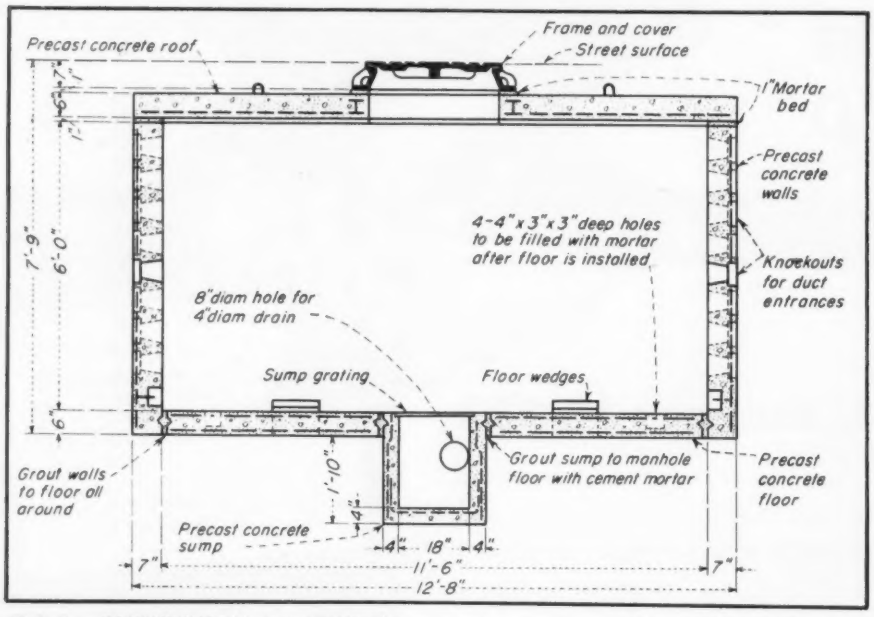


FIG 1—CROSSECTION OF TYPICAL precast concrete manhole. Width 5 ft 8 in. overall, 4 ft 4 in. inside

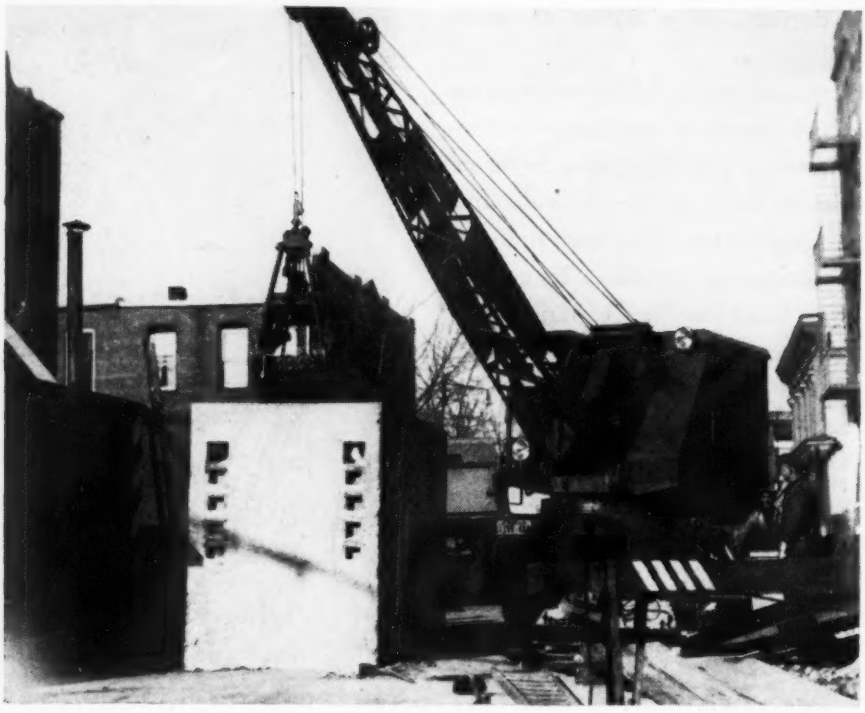


FIG 2—CRANE WAS USED TO LOWER manhole walls from truck to ground, then clamshell bucket was attached to remove earth from inside the caisson walls.

FRANKLIN J. JOHNSON
Assistant Engineer
Consolidated Edison Co of New York Inc

PRECAST CONCRETE manholes have been used for cable splice chambers and submersible type transformers by the Consolidated Edison Co. of New York, Inc. since August 1938. There are approximately 2,000 of these manholes in use on this system ranging in size from 7 x 4 ft with 5-ft headroom to 15 x 5 ft with 7 ft headroom.

The manholes are designed and constructed in separate parts. The four walls are designed to be sunk as a caisson and are cast as a single unit to form a rigid frame structure. The other units are the floor and roof slabs and a precast sump. All of those units are constructed in the shop using steel forms. This eliminates construction delays caused by varying field conditions. After the forms are removed, the manholes are stored in the yard which assures thoroughly cured concrete before installation in the street. Fig 1 shows a typical assembly of a precast cable manhole.

Steel reinforcement used in the manholes is shaped and spot-welded in a jig, making prefabricated units for convenience in placing in the form. Duct openings are provided by concrete blocks coated with paraffin to prevent a tight bond. These blocks are placed in the forms and cast in the walls; later they are knocked out in the field as required.

The site of a manhole installation is studied very carefully, using all available subsurface structure records so that the location chosen will be free of any obstructions. As an additional precaution, a survey of the area is made with an electronic device to locate any metallic subsurface structures such as gas or water pipes that may be present.

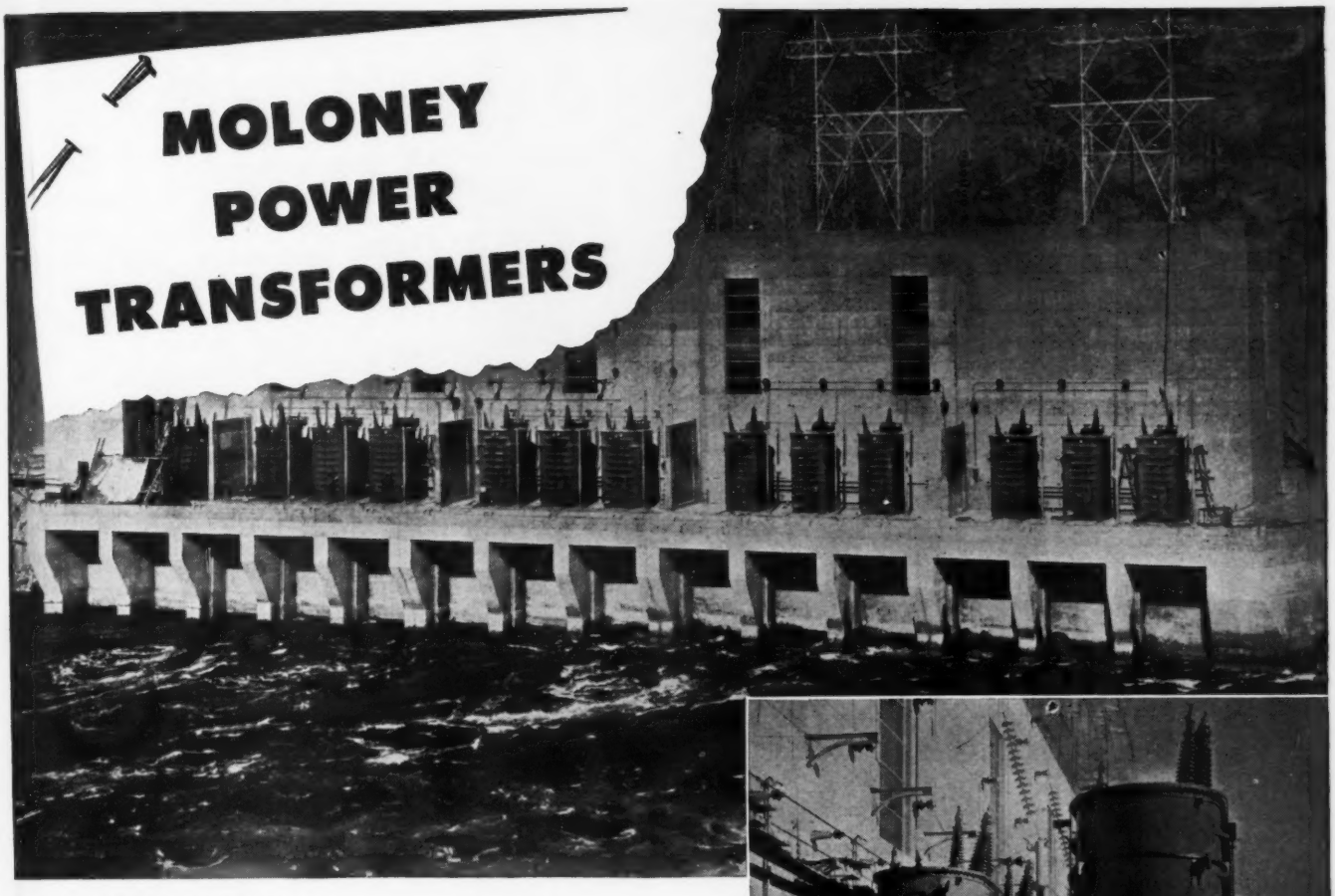
Installation Procedure

First step in the actual installation is to cut and remove the pavement from the area. Then when the manhole walls are placed, the earth is removed from inside as illustrated in Fig 2. At intervals two men with shovels are sent into the manhole to remove the earth remaining under the walls thus causing the walls to sink as a caisson. That process is repeated from three to six times until the walls have been lowered to the required depth. The sinking of the caisson walls usually takes from 1 to 1½ hr to complete and eliminates the use of temporary sheeting, thereby saving field time and expense.

A precast sump pit is then placed at the proper location and elevation after which the sub-grade for the floor is leveled and tamped prior to placing the precast floor slab. The openings between the floor and walls are then grouted with cement mortar. In the case of a transformer manhole the floor is secured to the walls by bolting so that a transformer can be set immediately without waiting for the grout to harden.

The precast roof slab or grating in the case of transformer manholes is

MOLONEY POWER TRANSFORMERS

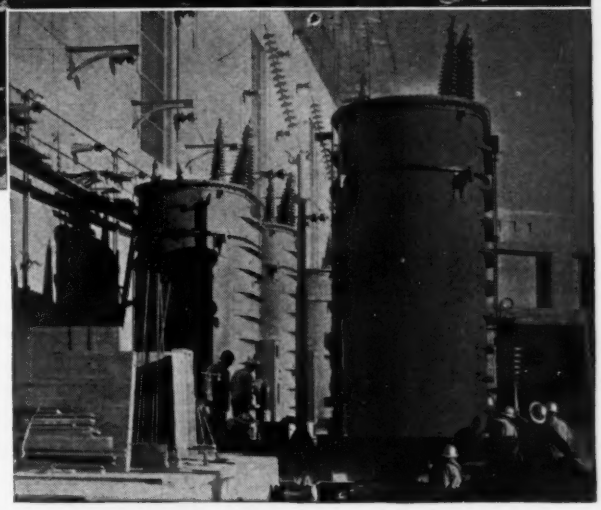


Bureau of Reclamation Photos

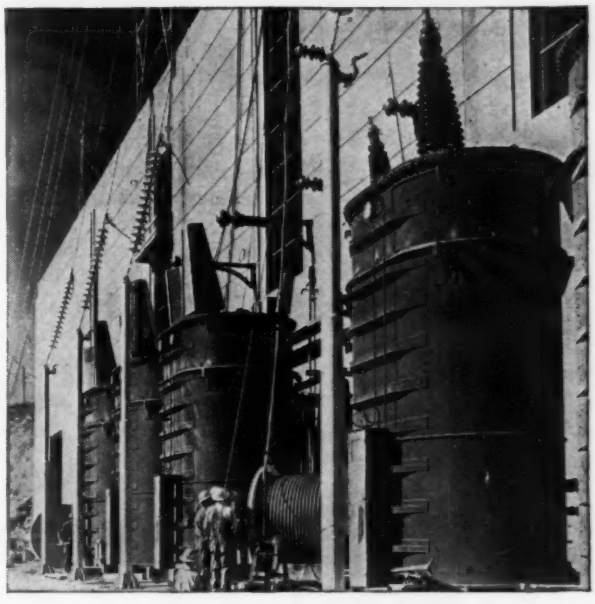
Like thousands of other Moloney Power Transformers, these 10,000 Kva water-cooled units are doing a good job 24 hours a day. Twelve of them are used at this hydro-electric plant to step up generator voltage to suitable transmission voltages. A thirteenth is used as a spare.

Nine of the transformers are rated 6800 to 92955/161000Y volts. The other four are similarly rated but have an additional 39840/69000Y volt winding of 10,000 Kva capacity, permitting a selection or combination of transmission voltages.

These transformers have been providing dependable service since 1943 and, based on past records of numerous other Moloney installations, will continue to do so for many more years. The dependability of well-designed, well-built transformers is yours when you specify Moloney.



Moving transformer into place from transfer truck.



Preparing to connect transformers for operation.

MOLONEY ELECTRIC COMPANY

TRANSFORMERS EXCLUSIVELY SINCE 1896

SAINT LOUIS 20, MISSOURI

the worst fires start when your plant is unprotected!

Syracuse, Indiana — Trailer Mfg.
1 dead; $600,000

Fire, confined to a storeroom when discovered by the watchman, spread to stocks of paint and lumber in a large 1-story factory. A neighbor assisting firemen was trapped within the building.

Dee, Oregon — Warehouse
$205,000

Flames discovered coming from the roof of a large 1-story wooden warehouse by a watchman at 3:45 A. M. spread to 1,400,000 ft. of lumber stored in the yard of a nearby sawmill.

Marion, Ohio — Conveyor Mfg.
$350,000

Fire believed caused by a defective water cooler motor spread to painting material stores nearby. At 4:15 A.M., outsiders discovered the flames out of control in the large area 1-story building.

Reports of the National Fire Protection Association, month after month, show that the most costly fires start at night. The basis for this is logical; a small fire starts . . . there is no one there to spot it or to put it out . . . undetected, it grows rapidly . . . then the watchman, or often a passerby, discovers it . . . too late.

The new C-O-TWO Combination Smoke Detecting and Fire Extinguishing System is a 24 hour a day automatic fire watchman. It provides the fastest type of fire protection known. The first whiff of smoke in a protected area sounds an alarm. Then fast, clean, non-damaging carbon dioxide blankets the fire, putting it out in seconds, before it spreads and causes extensive damage. C-O-TWO is safe as well as highly effective on flammable liquid and electrical equipment fires.

Be sure that your flammable liquid hazards, electrical equipment, record and storage vaults . . . all of your fire hazards are completely protected 24 hours a day. Let an expert C-O-TWO Fire Protection Engineer advise you on your fire protection needs now before fire strikes. Write today . . . tomorrow may be too late.

C-O-TWO

C-O-TWO FIRE EQUIPMENT COMPANY

NEWARK 1 • NEW JERSEY

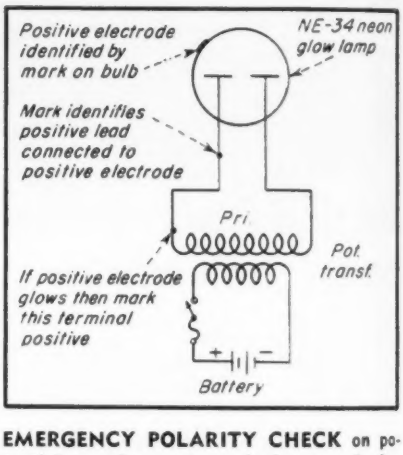
Sales and Service in the Principal Cities of United States and Canada

AFFILIATED WITH PYRENE MANUFACTURING COMPANY

set on the walls using a cement mortar grout cushion. Backfill is immediately placed around the edge of the manhole and traffic is allowed to resume over the location.

There are some locations where the excavation is completed before placing the precast walls, floor and roof. Time can also be saved by this method of installation because the concrete is set and ready to withstand roadway traffic.

With the exception of the final restoration of the top pavement, the entire field operation including the placing of a transformer is easily complete in one 8-hr day, whereas to construct a transformer manhole in the field normally requires approximately 5 days.



EMERGENCY POLARITY CHECK on potential transformer is made by use of glow lamp and battery

Emergency Polarity Check With Glow Lamp

A F STILSON
Galesburg, Ill.

WHEN INSTRUMENTS and a proper source of power are not available, an emergency polarity check on potential transformers or metering tanks can be made with a neon glow lamp such as the General Electric Co's type NE-34. Advantage is taken of the fact that only one electrode glows when the lamp is connected to a source of direct current. Which electrode glows depends upon which lead of the lamp-socket is connected to the positive source.

The lamp is "calibrated" by connecting a marked lead to a positive d-c source, for example, a radio "B" battery, with sufficient voltage to make the lamp glow, and marking a dot of white paint on the side of the

INTRODUCING!

THE NEW SYLVANIA INDUSTRIAL FIXTURES
FINEST FOR CONTINUOUS ROW INSTALLATIONS!

COMPLETELY WEATHERIZED!

Weatherized steel parts protect these fixtures against high-humidity conditions. This unique weatherizing process gives overall protection as never before—amazing resistance to atmospheres laden with moisture . . . plus unequalled reflection qualities from Sylvania's exclusive Miracoat finish.

This protective coating is important for all industries, but is especially essential in industries such as Textile, Leather, Food, Chemical, Paper, Wood, and Metal Working plants.

ONE-YEAR GUARANTEE

Complete installations of 100 or more units in one place are fully guaranteed *against failure* of all parts *including fluorescent lamps*, for one full year.

With...

THE NEW SYLVANIA HFF-240 AND HFF-440

- ✓ There is only ¼" space between reflectors — making it in effect an unbroken sweep of light the entire length of each row.
- ✓ Can be end-to-end mounted without the use of joining bands. Bushings and locknuts are provided with each unit, for this purpose.
- ✓ Turned down lip on reflectors eliminates possibility of catching dust, lint, and moisture—easy to maintain.
- ✓ Strong—the chassis is formed from a single sheet of 20-gauge steel.
- ✓ No internal cross-bracings, nuts, bolts or welds to interfere with the branch circuit wires which may be drawn through the chassis. Underwriters' approved.
- ✓ Seven possible mounting methods give you maximum flexibility in installation. Frequent knockouts permit great freedom in wiring and conduit suspension.

Designed to give the effect of unbroken lines of fluorescent illumination, these latest Sylvania products embody all the other features that your customers look for in rugged, high quality fixtures.

In short, these new industrial units are the most advanced, most practical fixtures you can recommend. Write us today for full particulars. Sylvania Electric Products Inc., Fixture Division, Ipswich, Massachusetts.

SYLVANIA ELECTRIC

MAKERS OF FLUORESCENT LAMPS, FIXTURES, WIRING DEVICES; ELECTRIC LIGHT BULBS; RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES

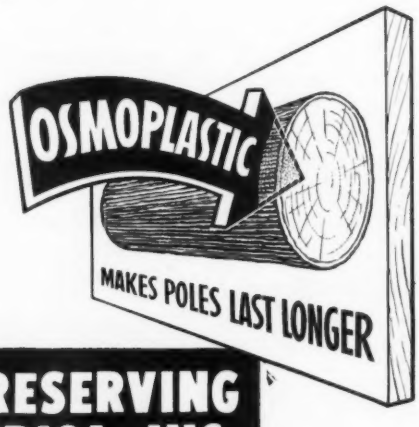
DO YOU KNOW ?

THAT OVER 3,000,000 STANDING POLES* HAVE BEEN GROUNDLINE TREATED TO DATE WITH

OSMOPLASTIC

There must be a Reason for this Acceptance - Write for the facts!

*WORK PERFORMED ON 68 LEADING UTILITY PROPERTIES



OSMOSE WOOD PRESERVING COMPANY OF AMERICA, INC.
GENERAL OFFICE AND PLANT: BUFFALO 12, N. Y.

lamp on which the electrode glows.

Battery voltage to use depends upon the transformer ratio. The higher the transformer ratio, the lower the d-c voltage is needed on the secondary winding to flash the bulb on the primary. For the ordinary 20:1 ratio, 2300-v potential transformer, a 5 or 6-v battery should generate a striking voltage for the neon lamp which glows at 105 v. In other cases a few penlight cells or a hearing-aid "B" battery will be ample.

Referring to the diagram, the negative side of the battery is shown connected to the unmarked secondary terminal of the potential transformer and the marked secondary lead is left open. The neon lamp has the known positive electrode and its associated lead connected to the primary through its marked terminal. The positive lead of the battery is then touched quickly and firmly to the marked terminal of the transformer and removed.

If the polarity markings are correct the "known" or marked electrode of the neon bulb will flash briefly when the positive of the battery is connected to the "marked" terminal, and the opposite electrode will flash when disconnected. The reverse happens if polarity should happen to be incorrectly marked.

Life of Windings On Rotating Machines—I

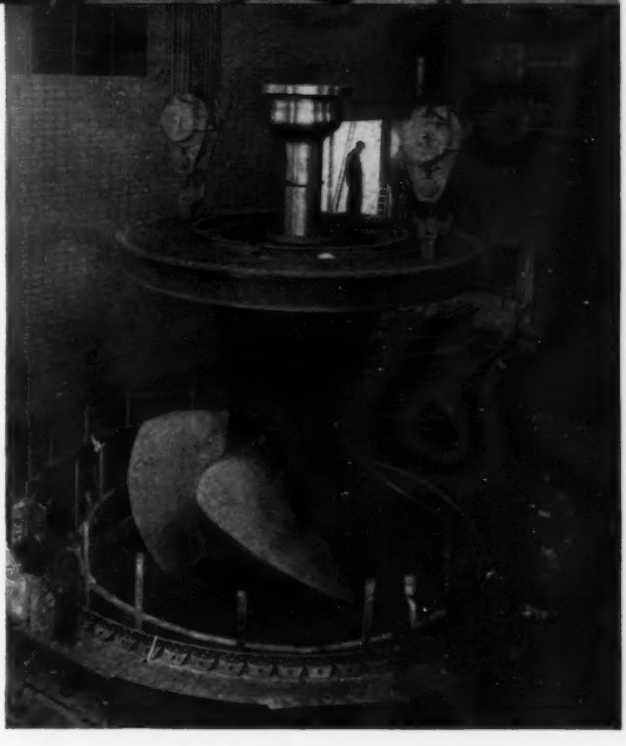
A. F. AYRES*
Ass't Electrical Engineer,
California Electric Power Co
Riverside, Calif.

The purpose of this series is to discuss insulation testing and classification and to specifically indicate actual operating experience of the California Electric Power Co with generator and transformer windings.

The utility mentioned does not make a practice of applying power factor, ionization or oil analysis tests at periodic intervals. Such tests, unless carried out at regular periods, have been found to be of little value in forecasting the life expectancy of any winding. Some such tests require moving the generator stator away from the rotor, thus inviting accidental damage to already weakened insulation. With or without the re-

*First in a series of four on life of windings

Performance is verified *before* BALDWIN TURBINES *are* BUILT



As every hydraulic engineer knows, *you can't build a turbine out of a textbook!*

In every installation there are a dozen unpredictable variables that must be investigated and evaluated . . . and the results applied to modify and refine the theoretical design.

One primary job of the Baldwin Hydraulic Laboratories is to construct complete homologous model units—including racks, intake case and draft tube—and make painstaking studies of operation under accurately simulated service conditions. Any "bugs" are eliminated at this stage, and the groundwork laid for the top efficiency and outstanding performance that distinguish Baldwin turbines in the field.

Baldwin Turbines are available in Impulse, Francis, Adjustable Blade and Fixed Blade Propeller types to meet every head condition. Capacities range from less than 1 horsepower to over 100,000. Ask for Bulletin 252 for details.

BALDWIN

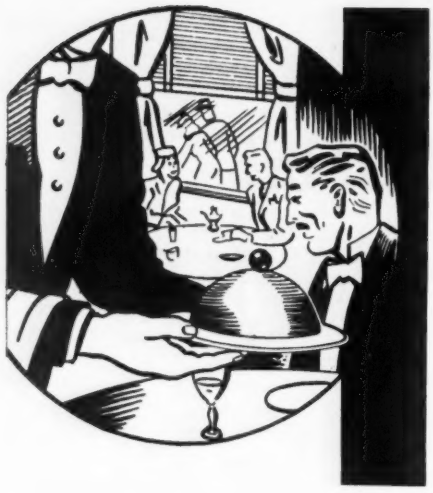
HYDRAULIC TURBINES

BLW "THE BALDWIN GROUP"

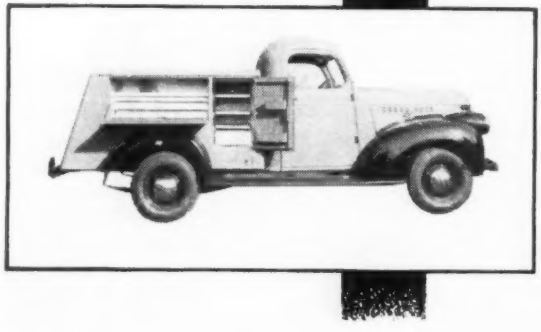
THE BALDWIN LOCOMOTIVE WORKS
PHILADELPHIA 42, PA.

THE PELTON WATER WHEEL COMPANY
2929 Nineteenth St., San Francisco 10, Cal.

Offices: Birmingham, Boston, Chicago, Cleveland, Houston, New York, Philadelphia, Pittsburgh, San Francisco, Seattle, St. Louis, Washington. In Canada: Baldwin Locomotive Works of Canada, Ltd., Toronto, Ontario.



It takes DEPENDABLE SERVICE to keep customers . . .



that's why YORK-HOOVER BODIES are re-ordered again and again

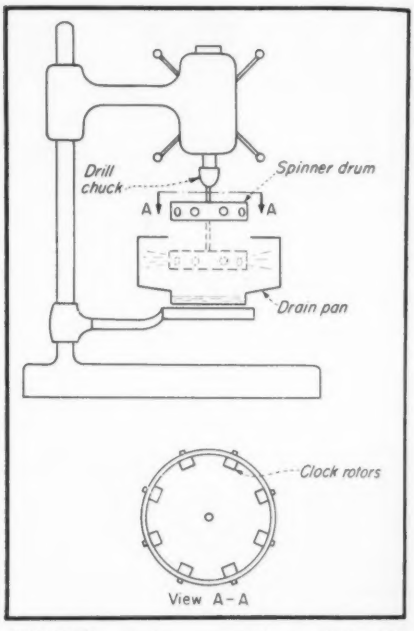
Specific purpose design — dependable service — low maintenance service—that's what operators are getting from YORK-HOOVER BODIES. And so the number of York-Hoover repeat customers is constantly growing.

To meet this healthy, steadily growing demand, York-Hoover has increased plant and production facilities so that we hope to say "prompt deliveries" in the not too distant future.

YORK-HOOVER BODY DIVISION CORPORATION

YORK, PENNSYLVANIA

sults of such tests, the final statement as to the anticipated remaining useful life of a generator or transformer winding appears to rest mainly on the judgment of the utility or manufacturer's engineer. From experience, it seems that such estimates are somewhat subjective and at times approach the extreme of an illusion.



SPINNER device mounted on light drill press expells oil from Telechron clock rotors

Spinner Device Drains Clock Rotors

DRAINING OIL from Telechron clock rotors is a messy job at best. But at the meter shop of the Metropolitan Edison Co, Reading, Pa. the job has been reduced to its simplest terms with a centrifugal device that mounts on a light bench type drill press as shown.

Rotors to be drained are set in holes around the rim of a spinner drum whose shaft fits into the drill chuck in the usual way. Oil expelled from the open end of the clock rotors, as the spinner turns, is caught in an encircling drain pan that rests on the bed of the press.

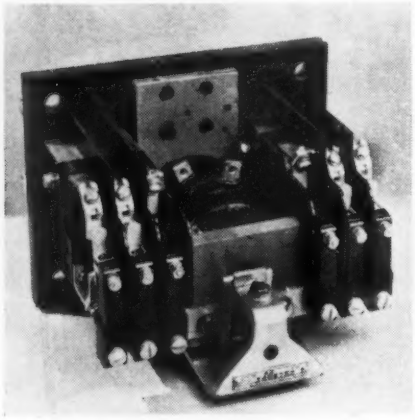
The spinner is loaded when the operating handle of the press is in the retracted position. Then, as the spinner starts to turn, the operating handles of the drill press lower it into the drain pan to catch the flying oil.

It is the matter of a few seconds work to remove the spinner and drain pan if the drill press is needed for other work.

G-E 4-LAMP PACKAGES

SIGHT

NEW EQUIPMENT



Heavy-Duty Relay

A NEW HEAVY duty, rear connected, multiple d-c magnet-operated relay is announced by Westinghouse Electric Corp, 306 Fourth Av, Pittsburgh 30, Pa. Designated the AYB, the relay is available in 4, 6, 8, 10, 12 or 14-pole combinations. It is suitable for use on machine tools, in steel mills and for other heavy duty applications requiring interlocking of circuits.

The AYB relay is designed for operation on 600 v and below. All contacts are double-break silver to silver and will carry 10 amp continuously at rated voltage. Its salient feature is a fast drop-out of the contacts when the coil is de-energized. Contacts can be had normally open, or some normally open and some normally closed.

The relay is a self-contained unit with all component parts mounted on a ½-in. thick Micarta back plate and can be mounted easily on a control panel two-in. thick or less. A mechanical interlock assembly is available for interlocking two relays side-by-side and on the same horizontal centerline. Stationary contacts can be removed from the front of the relay.

•

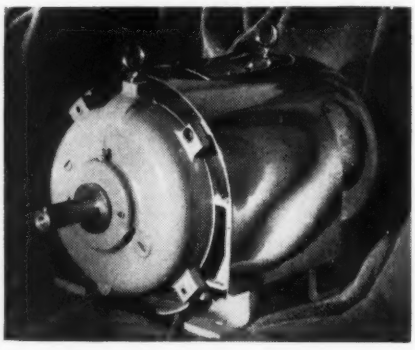
Torque Control System

A REMOTE TORQUE control system for industrial applications has been developed by Eclipse-Pioneer Division, Bendix Aviation Corp, Teterboro, N. J. Some applications are operation of valves and gates, setting signals, control of parts of motors, and liquid level control.

Units are a transmitter Autosyn, a torque unit and an amplifier. Autosyn rotor shaft is operated manually or by a sensitive element, and its position determines the position of the torque unit output shaft. The amplifier supplies the controlled power required to operate the torque unit. An Autosyn Differential can be applied if more than one regulating quantity is involved.

These systems are designed to operate on single-phase, 110-v, 60-cycle power. Maximum static error between the transmitter Autosyn and the coupling Autosyn of the torque unit is reported to be 0.15% under no-load condition. Several gear ratios and motor sizes are available to provide torque outputs ranging from a few gram-centimeters to several foot-pounds.

•

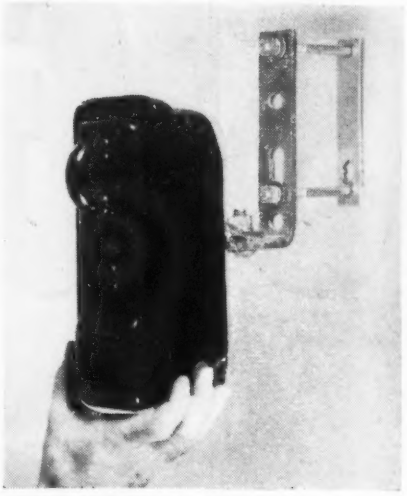


Chemical Motor

A CORROSION-RESISTING a-c motor for application in chemical industry has been developed by Reliance Electric & Engineering Co, 1088 Ivanhoe Road, Cleveland 10, Ohio, and will be offered in frame sizes 203 through 326.

Built to standards set for Class 1 Group D operation, the new motor has also been designed as an explosion-proof unit. By addition of a multi-conductor cable, rubber hose, and suitable packing glands, the motor is reported to meet specifications of the Bureau of Mines for use on "permissible" equipment.

Monel metal has replaced steel in the outer cover and in the fan cover. The lead outlet of steel channel has been replaced by a lead enclosure with a monel pipe nipple going directly into the inner enclosing shell. The motor has cast-iron brackets. Cast bronze is used for the fan; brass for grease pipes and screws; fine grained cast iron for conduit box; and cadmium-plated steel for bolts holding the outer fan.



Indicating Cutout

A 50-AMP indicating enclosed fuse cutout has been announced by the Transformer and Allied Product Divisions of the General Electric Co. It is designed for use on high-capacity distribution feeders, and has an interrupting rating of 5000-rms amp at 5,000 v, and 8000-rms amp at 2500 v.

Housing of the cutout is wet-process porcelain, glazed inside and out, with a hanger support cemented into the back. Contact clips and terminals are silver plated, and cemented into the housing. When the fusible section of the fuse-link melts, a spring-operated indicator arm pulls the cable downward and completely out of the tube, assuring quick interruption even with 1-amp links, it is stated.

Door is molded Textolite and has hinges so positioned that recoil forces act to hold the door closed. An indicating arm projects from the bottom of the door, showing that the fuse has blown. Additional information is given in publication GEA-5019.

•

Indenting Tool

A LIGHTWEIGHT portable pneumatic Hypress for indenting smaller sizes of Hylugs and Hylinks can now be obtained from the Burndy Engineering Co. Inc, 107 Bruckner Boulevard, New York 54, N. Y. This tool, Polypress Y8NA, achieves its light weight through the use of aluminum alloys.

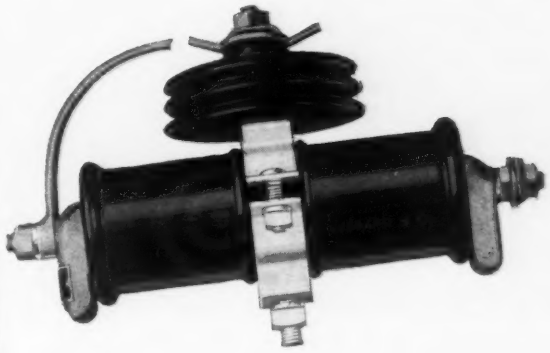
For safe operation, the jaws of the Hypress remain closed with sufficient

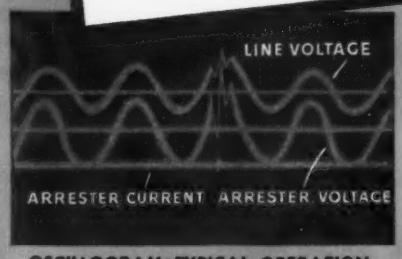
CHEAP WORKING INSURANCE WITH HUBBARD AUTOGAP

Hubbard Autogaps

are furnished in three sizes with maximum arrester voltage ratings of 3000 V., 6000 V. and 9000 V. Also furnished with drop-out fuses. Attachment Brackets are available for transformer, pole or arm without extra cost. Specify type of mounting desired.

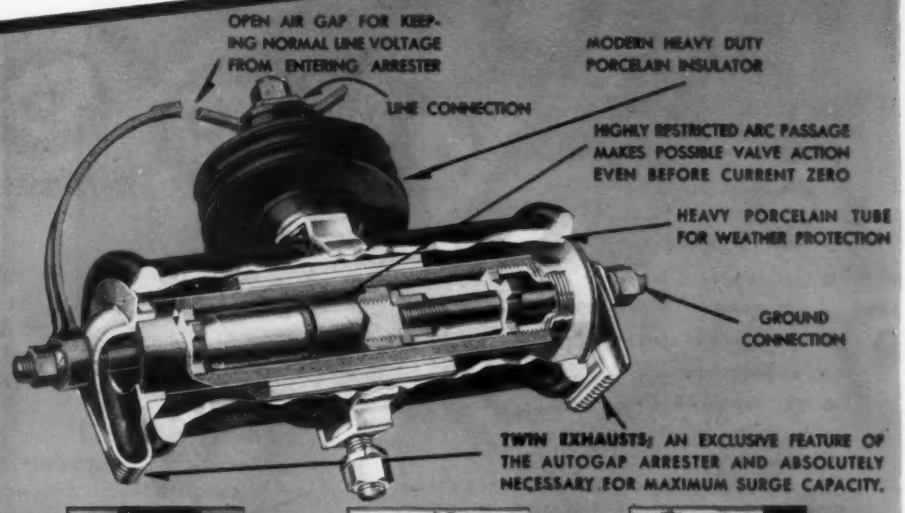
The cut-away drawing and oscillograms show the construction and operation of the Hubbard Autogap principle. Years of service in the field, with no failures, is the achievement of the Autogap, the most outstanding Lightning Arrester ever built.





OSCILLOGRAM•TYPICAL OPERATION

ACTUAL OSCILLOGRAM•SURGE CURRENT


OPEN AIR GAP FOR KEEPING NORMAL LINE VOLTAGE FROM ENTERING ARRESTER
LINE CONNECTION
MODERN HEAVY DUTY PORCELAIN INSULATOR
HIGHLY RESTRICTED ARC PASSAGE MAKES POSSIBLE VALVE ACTION EVEN BEFORE CURRENT ZERO
HEAVY PORCELAIN TUBE FOR WEATHER PROTECTION
GROUND CONNECTION
TWIN EXHAUSTS; AN EXCLUSIVE FEATURE OF THE AUTOGAP ARRESTER AND ABSOLUTELY NECESSARY FOR MAXIMUM SURGE CAPACITY.

MOUNTINGS

HUBBARD AND COMPANY

Pittsburgh *Chicago*

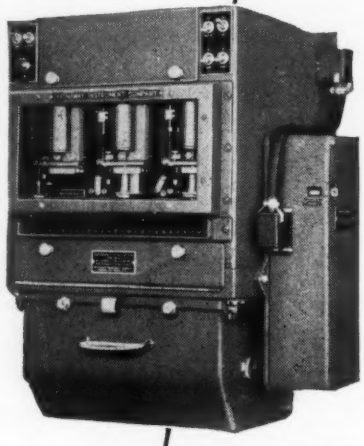
Oakland, California

Recorder of System Faults

The Type RS-9 Automatic Oscillograph waits indefinitely until a trouble occurs, then it is in full speed in 1-500 second, accurately recording cycle-by-cycle magnitudes, wave shapes, phase relations, short-circuit currents, relay and circuit-breaker operations.

No power transient is too fast for the RS-9. It will record the *first peak* values of current, voltage, or power!

- Twelve elements
- Galvanometers for current, voltage, or power
- 1 to 3 built-in starting relays
- Ten-inch chart
- Precision fine-line records
- Simple to adjust, service, and use



Hathaway Type RS-9
Twelve-element Recording
Oscillograph

FOR AUTOMATIC OR MANUAL OPERATION
FOR SWITCHBOARD OR PORTABLE MOUNTING

**THE MOST VERSATILE
OSCILLOGRAPH FOR
THE CENTRAL-STATION ENGINEER**

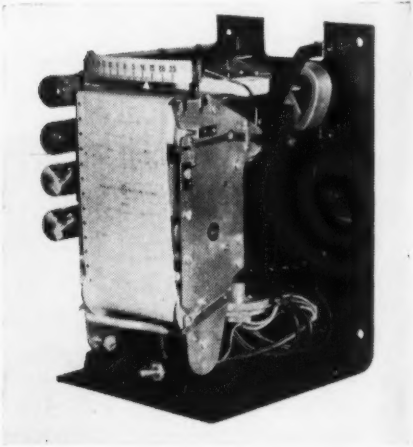
Write for Technical Bulletin SP-196G

Hathaway
INSTRUMENT COMPANY
1315 SO. CLARKSON STREET • DENVER 10, COLORADO

pressure to hold the connector-and-cable assembly in place and they remain closed until opened by thumb pressure on the jaw depressor. A long hand-trigger permits use of the tool in any position. Removable dies accommodating conductors from No. 8 to No. 22 AWG are set in compact jaws. The jaws are said to allow ample clearance for correctly locating the connector-and-cable assembly for indenting.

Polypress delivers about 2000 lb indenting force from an air pressure of 80 to 100 lb. Lower pressure can be used for the smaller size connectors.

•



Photoelectric Wattmeter

A PHOTOELECTRIC recording wattmeter, designed for such applications as analyzing welding circuits and measuring industrial heating load, motor-starting load, and power surge, has been announced by the Meter and Instrument Divisions of the General Electric Co. Consisting of a high-speed photoelectric recorder and a newly designed wattmeter measuring unit, the new instrument can be used to measure d-c power or a-c power up to 10,000 cycles per second.

Chart speeds of a half in. per hour up to 72 in. per minute are reported obtainable. When the instrument is calibrated for a particular frequency, accuracy is said to be plus or minus 3%. When calibrated for 60 cycles, it can be used over the entire range of from 60 to 10,000 cycles at unity power

SPLITS your load in two!

Radial and thrust bearings for combination loads

Since Right-Angle-Loading splits all compound loads into pure thrust and pure radial, Rollway Precision Type Bearings actually last longer. Radial bearings carry all radial loads and Thrust bearings carry all thrust loads. No complex resultant forces. No end-rub. No wear-back or pinch-out.

Furthermore, solid cylindrical rollers permit greater load capacity and tend to roll in non-skewing, trackless friction.

Hence, better performance . . . longer bearing life . . . minimum maintenance.

ROLLWAY BEARING COMPANY INC.
SYRACUSE, N. Y.

ROLLWAY
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BEARINGS

OFFICES IN PHILADELPHIA • BOSTON • PITTSBURGH • CLEVELAND • DETROIT
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Flexibal

GUY WIRE GUARDS WILL *SAVE YOU MONEY!*

The Flexibal Guy Guard is smoothly shaped of hard-wood, and coated with an enduring aluminum paint.

Lower Cost Guy Wire Protection with FLEXIBAL wooden guy guards

1. **Lower First Cost.** Flexibal guy guards now cost less than any other type. They save money.

2. **Quick Easy Installation.** There's only one nail to drive home. You install 7 foot guard in 2 minutes. Flexibal guy guards save you money.

3. **Less Maintenance Bother.** Flexibal guy guards are flexible. They bend, don't break. Stay in first class shape longer. They save you money.

4. **Longer Life.** Flexibal guy guard pictured at top of this ad has been in place 8 years on exposed corner location. This long life of useful service saves you money.

5. **Complete Safe Protection.** Flexibal guy guards have top visibility day and night. They bend, don't break. They cut liability costs . . . and save you money.

6. **Test Them at No Cost.** Write on your business letterhead for set of Flexibal guy guards to be sent prepaid at no cost. Try them, and let them prove their advantages.

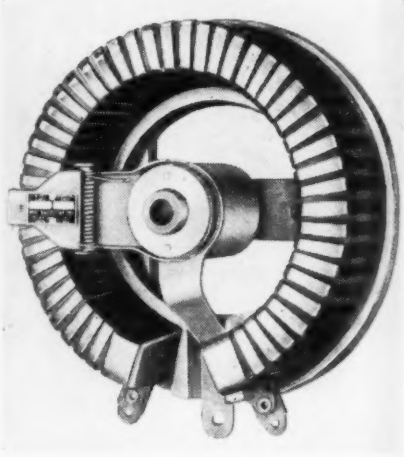
FREE Trial Set of FLEXIBAL Guy Guards

SET of Flexibal guy guards for 7 foot length will be sent at no cost for test. Write on your business letterhead.

S. E. OVERTON CO.
SOUTH HAVEN, MICHIGAN

factor with an error of plus or minus 5%. Power-factor error when going from 0.5 lagging to 0.5 leading is only plus or minus 3%. The current circuit is rated either 5 or 10 amp and the potential circuit either 120 or 240 v. Transformers can be used to extend this range if necessary.

•

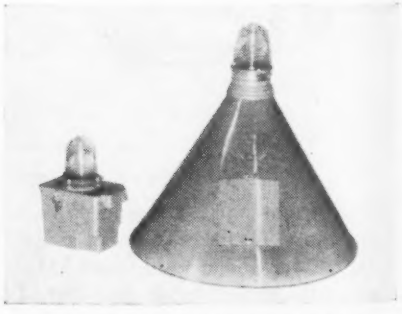


Round Rheostats

DEVELOPMENT of round rheostats having resistance wire or ribbon wound on a ceramic core is announced by Rex Rheostat Co, 3 Foxhurst Road, Baldwin, L. I., N. Y. The resistance windings are said to be kept tightly in position by a protective coat of vitreous enamel. Seven sizes are available in ratings 50 to 500-w, 0.07 to 22 amp, and 2⅜ to 8 in. O.D.

The rotatable contact arm consists of a center truss spring hinged to a holder for the contact block of copper-graphite or silver-graphite. A self-lubricating washer has been added between the stationary center terminal and movable contact arm.

•



Portable Marker Lights

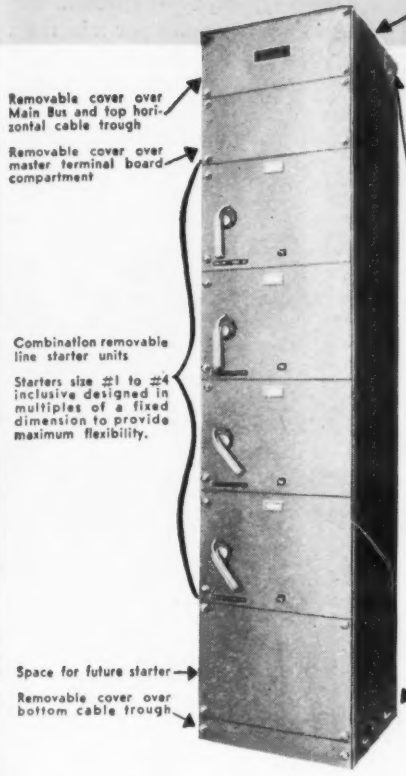
FLASHING PORTABLE marker lights suitable for marking temporary hazards on streets or highways or as airport obstruction indicators are announced by the Westinghouse Electric Corp, Pittsburgh 30, Pa. Type S-1373146 is for nighttime use only, and type S-1373147 with an international orange cone is effective for both day and night use.

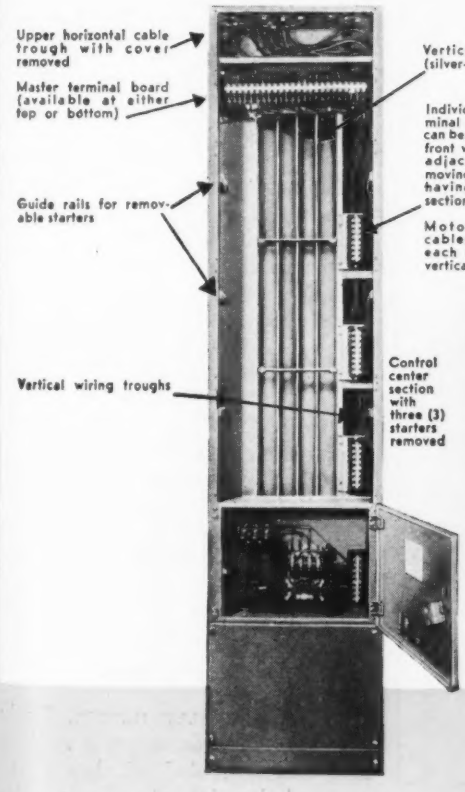
Coiled neon-tube type lamps are

only FEDERAL NOARK CONTROL CENTERS have *ALL* these features

Because Federal NOARK Control Centers are COMPLETE . . . they're *easier* to buy, install, extend, rearrange, relocate, and service!

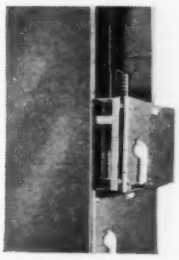
For details . . .
contact the Federal NOARK District Office.


Removable cover over Main Bus and top horizontal cable trough
Removable cover over master terminal board compartment
Combination removable line starter units
Starters size #1 to #4 inclusive designed in multiples of a fixed dimension to provide maximum flexibility.
Space for future starter
Removable cover over bottom cable trough
Removable cover for extension of top horizontal cable trough when additional sections are added. These covers are on both sides of sections.
Removable cover for extension of main bus when additional sections are added. These are on both sides of sections
Designed so that one vertical section can accommodate sizes #1 to #4 starters.
Bottom cable troughs with cover removed

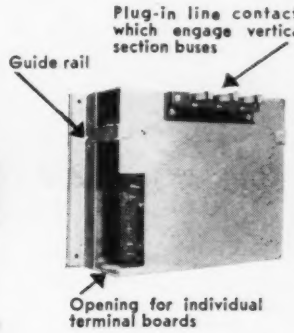

Upper horizontal cable trough with cover removed
Master terminal board (available at either top or bottom)
Guide rails for removable starters
Vertical wiring troughs
Vertical section buses (silver-plated)
Individual starter terminal boards. Starters can be removed from the front without disturbing adjacent starters, removing rear plates, or having loose wires in section.
Motor and control cables isolated from each other and from vertical buses.
Control center section with three (3) starters removed

Same vertical section used for front mounting or back-to-back arrangements.

Size #1 to #4 starter. Line plug eliminates necessity of shutdowns or working "hot" connections to remove starters.



View showing removable starter unit partially removed and being supported by its channel guides



Rear-view of removable combination line-starter unit

Federal NOARK *Control Centers*

Executive Offices: 50 Paris St., Newark, N. J.
Plants: Hartford, Conn.; Newark, N. J.; St. Louis, Mo.; Long Island City, N. Y.

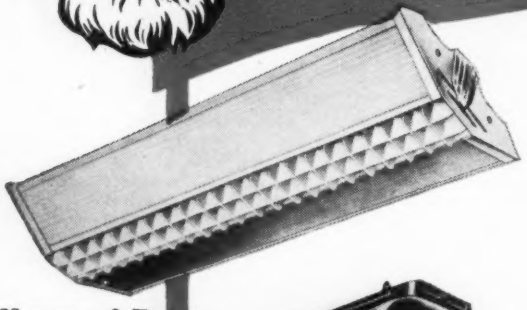
Sales Offices in Principal Cities
Federal Electric Products Company, Manufacturers of a Complete Line of Electrical Products, including Motor Controls • Safety Switches • Service Equipment • Circuit Breakers • Panelboards • Switchboards • Bus Duct

THANK YOU
for being discriminating!

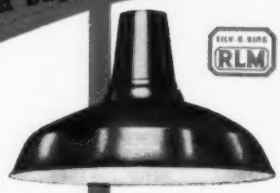
When buyers start demanding Quality Lighting Equipment — We're happy!

When they want quality Lighting Equipment at Economy Prices — we bubble over with joy! — Because then our business really booms!

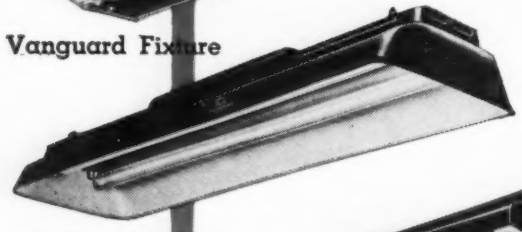
Here is some of the BEST LIGHTING EQUIPMENT money can buy.



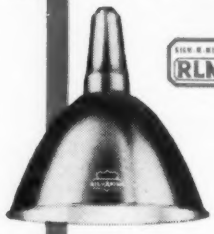
Vanguard Fixture



Standard Dome Reflector
RLM Specification No. 1



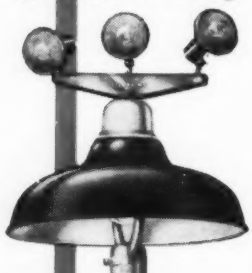
Specification Unit



Alzak Aluminum
High Bay Mounting

Continu-Lite

Slimline Unit



Island Light with attached
Trough and Flood Lamps

For the complete line of SILV-A-KING Flood-lighting Units, and all other Incandescent Reflectors, send for free Catalog #50.

NEW CATALOG

BRIGHT LIGHT REFLECTOR CO.
INCORPORATED
Subsidiary of BRIDGEPORT PRESSED STEEL CORPORATION
FAIRFIELD & STATE, BRIDGEPORT 5, CONN.

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Los Angeles, Cal.
Minneapolis, Minn.
New York, N. Y.
Philadelphia, Pa.
Pittsburgh, Pa.
Portland, Ore.
San Francisco, Cal.
St. Louis, Mo.

SILV-A-KING
LIGHTING EQUIPMENT

used in both types of lights powered by a standard, dry-type Hotshot battery. Flashed at 120 times per min the average life of the battery is 150 hr. Clear glassware is used with various colored lamps.

The battery housing is cast aluminum and the cone is lead-coated steel. All interior parts are made of non-ferrous, non-corrsive materials. Weight of type S-1373146 nighttime marker is 22 lb while the weight of the combination day and night marker with cone is 34 lb.

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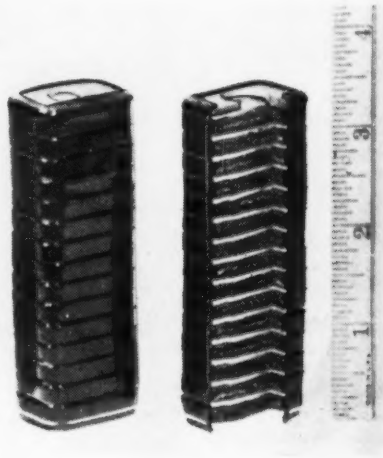


Flat-Cell Dry Battery

DEVELOPMENT OF a flat-cell dry battery with interlocking construction has been announced by the Electrical Division, Olin Industries, Inc., New Haven, Conn. The construction is reported to eliminate 91% of the soldered connections and increases battery life by approximately 20%.

Standardizing on rectangular shapes each individual cell produces approximately 1½v. The flat cells are said to range in size from about half the area of a postage stamp to 1½ in. square and from $\frac{3}{16}$ to $\frac{3}{8}$ in. thick. The cells are stacked. When two or more stacks are required to make up a battery, some soldering operations are required to join the stacks into one electrical unit. Illustration shows one of three stacks for a 67½-v B-battery.

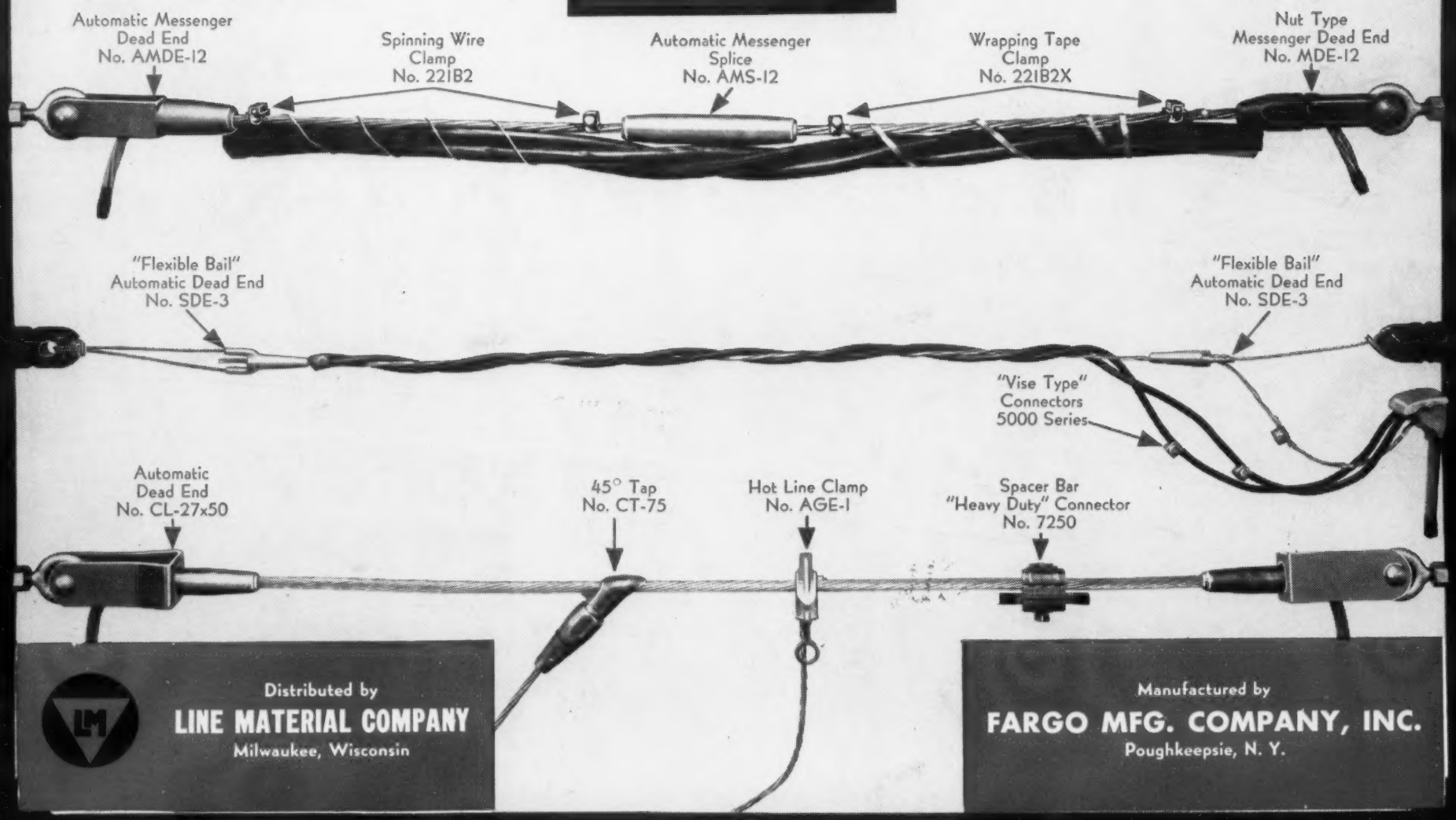
•

Electric Radiators

AN ELECTRICALLY HEATED, 3-column floor-type radiator, using a medium of hermetically sealed oil, has been announced by Atlantic Electric Meter Corp, 214 East 41st St, New York 17, N. Y. Heating is said to be evenly dispersed over a radiating surface of 20.15 sq ft per kw.

The radiator body is pressed steel tested to 100 psi, made up of 9 to 36 sections in heights 18, 24 and 30 in.

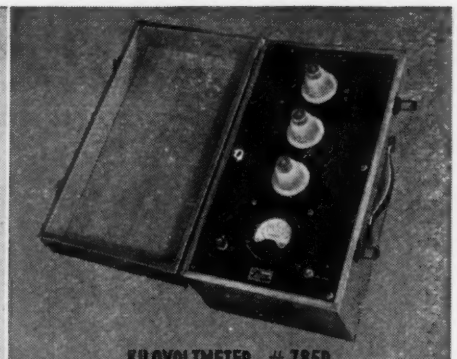
FARGO


Automatic Messenger Dead End No. AMDE-12
Spinning Wire Clamp No. 221B2
Automatic Messenger Splice No. AMS-12
Wrapping Tape Clamp No. 221B2X
Nut Type Messenger Dead End No. MDE-12
"Flexible Bail" Automatic Dead End No. SDE-3
"Flexible Bail" Automatic Dead End No. SDE-3
"Vise Type" Connectors 5000 Series
Automatic Dead End No. CL-27x50
45° Tap No. CT-75
Hot Line Clamp No. AGE-1
Spacer Bar "Heavy Duty" Connector No. 7250

Distributed by
LINE MATERIAL COMPANY
Milwaukee, Wisconsin

Manufactured by
FARGO MFG. COMPANY, INC.
Poughkeepsie, N. Y.

LOW-RESISTANCE TEST SET #670C
1,000 to 500,000 micro-ohms
(Other ranges from 200 micro-ohms to 100 ohms)



KILOVOLTMETER #785P
AC-DC 5-10-20 KV
(Other ranges from 1.5 to 200 KV)

Shallcross

KELVIN-WHEATSTONE BRIDGE #638-2
0.0001 ohm to 11.11 megohms
(7 additional designs and 15 types of percent limit bridges)

DECADE BOX #825
11,110 ohms in 1 ohm steps
(Other designs, 1 to 7 dials, from 0.1 to 11,111,110 ohms)

. . . for electrical measurements

VOLTAGE DIVIDER (Decade Potentiometer)
10,000 ohms total. Voltage ratio: 0.001 to 1.0
(Other 3- and 4-dial designs, 1,000 to 100,000 ohms)

Shallcross Electrical Measuring Instruments are made in many types — from sturdy, inexpensive bridges for school and production use, to fault location bridges, high-voltage test equipment, low-resistance test sets and numerous others.

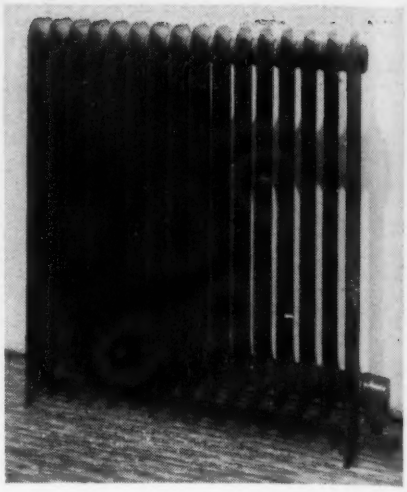
Write for Bulletin on any type.

AKRA-OHM PRECISION RESISTORS
14 Standard Types.
50 available special designs.

PRECISION SWITCHES
350 designs for instruments and high-grade electrical apparatus.

ATTENUATORS & CONTROLS FOR COMMUNICATION EQUIPMENT

Shallcross Manufacturing Co.
Electrical Measurement Specialists
Dept. EW-58 Collingdale, Pa.



and having heating surfaces from approximately 10 to 40 sq ft, requiring 0.5 to 2 kw. Sheath wire oil heating elements for standard voltages are inserted in the lower part of the radiator.

•

Multiple Welder

A MULTIPLE RESISTANCE-welding machine, actually two welders mounted opposing each other, has been designed and built by Sciaky Brothers, Inc, 4915 West 67th St, Chicago 38, Ill. Each of the units has a set of eight opposing electrodes, houses two transformers and the cabinet mounts electronic controls.

First application of the machine is the manufacture of wheels consisting of two stamped halves; each wheel takes 8 welds. Overload on the power supply is said to be avoided by dividing the complete weld into two firings. When the cycle is completed, electrodes retract and the welded part continues in a chute and into a bin. Electrodes and integral pressure units can be adjusted or reduced in number to accommodate wheels of different sizes. A special control is said to allow operation on a "balanced" 3-phase load with the company's "three-phase" type welder.

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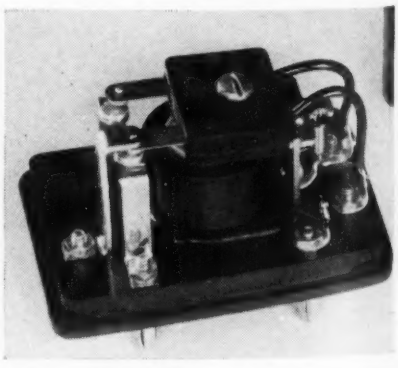
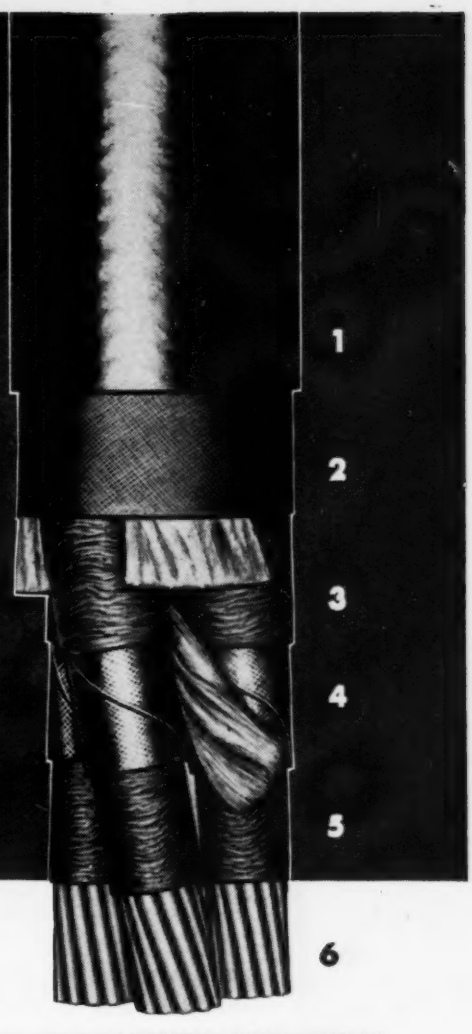


Plug-in Relay

UTILIZING PLUG-TYPE connectors, a new relay has been announced by Grayhill, Dept EW, 1 North Pulaski Road,

HOT SPOTS CAN'T SHORTEN THE LIFE *of Permanently Insulated* ROCKBESTOS A.V.C. WIRES and CABLES



Neither constant attack by the baking heat of hot steam lines, boilers and ash pits, nor severe heating and cooling cycles can cut down the long-lived endurance of Rockbestos A.V.C. wires and cables.

The impregnated asbestos insulation takes high operating and ambient temperatures *continuously* up to a maximum of 230°F., without breaking down or deteriorating.

It has ample moisture resistance to withstand condensation in conduit or duct installations.

It provides a safety margin in greater current carrying capacity through *higher* heat resistance.

The asbestos braid, like the insulation, won't deteriorate with heat or age; won't rot or bloom when exposed to corrosive fumes; and won't burn or support flame.

The three-conductor Rockbestos A.V.C. Power Cable illustrated is one of many standard types in a line of more than 125 permanently insulated wires and cables—including Lead Sheathed and Armored Power Cables in 600 to 5000 volt ratings, Secondary Network and Fireproof Vault Cables and Rockbestos All-Asbestos Wires and Cables.

WRITE TODAY—for your copy of the new No. 10-F Catalog, sectioned for easy reference to permanently insulated Lighting Wires, Power & Control Cables; Apparatus Wires & Cables; Switchboard, Appliance, Fixture, Electronic and Magnet Wires.

ROCKBESTOS PRODUCTS CORPORATION
231 Nicoll St., New Haven 4, Conn.

NEW YORK BUFFALO CLEVELAND DETROIT CHICAGO
PITTSBURGH ST. LOUIS LOS ANGELES OAKLAND, CALIF.

A PERMANENT ROCKBESTOS CONSTRUCTION THAT ASSURES LONG-LIVED SERVICE

The Rockbestos A.V.C. 600 Volt Power Cable illustrated has each conductor insulated exactly like single conductor Power and Motor Lead Cables (maximum operating temperature 110°C.) Also made with lead sheath or armor and in higher voltages.

1. A tough, non-aging impregnated asbestos yarn braid, resistant to heat, flame, moisture, oil, grease and fumes.

2. Tape binds jute fillers (asbestos if required) and cabled assembly securely.

3. Heat, flame and moisture resistant impregnated felted asbestos insulation that won't dry out, crack, rot or burn—also protects varnished cambric from heat and oxidation.

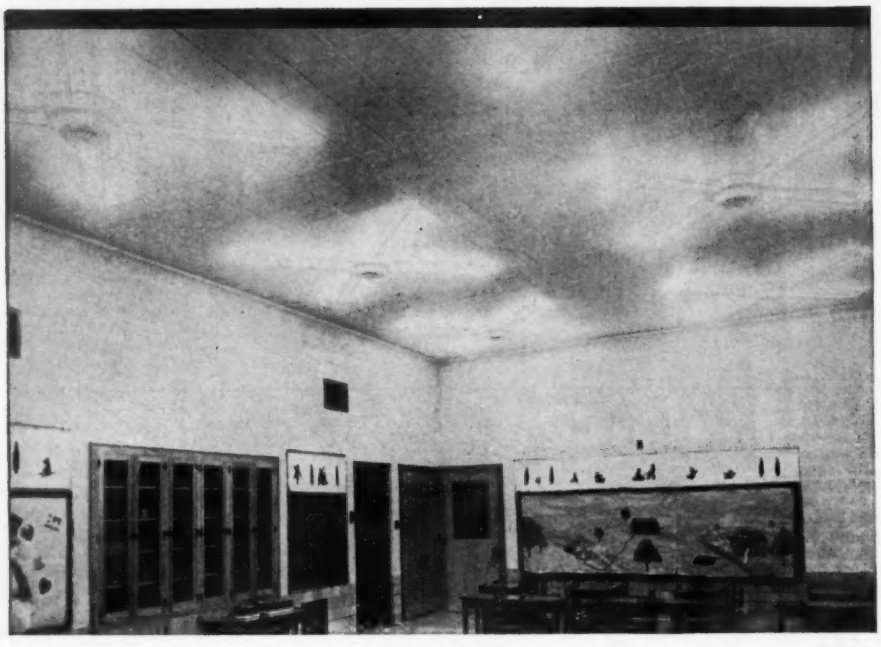
4. Varnished cambric for high dielectric strength and added moisture resistance.

5. Inner wall of impregnated felted asbestos which acts as a baffle between varnished cambric and hot conductors.

6. Conductors are perfectly and permanently centered in helically applied non-flowing heat resistant insulation that provides greater current carrying capacity.

One of 125 different constructions designed by Rockbestos for severe or unusual operating conditions.

ROCKBESTOS A.V.C. — *The Wire with Permanent Insulation*



Ideal for Class Room Lighting
...proved by actual tests

"*Hairpinline*"
U. S. PAT. PEND.

COLD CATHODE FIXTURES

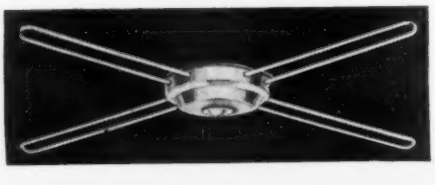
● In the final analysis the proof of any lighting fixture is its performance. It is by this standard that "HAIRPINLINE" Cold Cathode fixtures have proved superior in low surface brightness—in efficiency of lighting—in ultimate economy.

For example; in standard class rooms involving more than 15,000 lamps in 67 installations there was less than 1% replacement over an average period of 2 years.

"HAIRPINLINE" Cold Cathode fixtures are ideal for school lighting as they provide an even distribution of light over the entire class room—practically eliminate all shadows—and with the low lamp brightness require no louvers or glass to shield the lamps. They give approximately 100% light output.

Maintenance is practically nil, but in the event, a replacement is necessary you merely pull out the old lamp and insert a new one. A specially designed bracket facilitates quick—easy replacement.

For complete information we suggest you contact your local distributor.



UX-480 Lightaleer, Jr.—Designed especially for use with the modern cold cathode hairpin lamps and highly successful for class room lighting.

Illuminating Engineering Company
Designers and Manufacturers of Slimline and Cold Cathode Lighting Fixtures
2347 E. NINE MILE ROAD • • • HAZEL PARK, MICHIGAN

Chicago 24, Ill. The connectors are affixed to the bottom of the phenolic base which mounts the integral parts of the relay. Installation and replacement time is said to be a few seconds since the connectors are inserted into receptacles on a panel of the machine. The relay is adaptable to units such as machine tools and food and drinking dispensing machines.

The relay can be used on a-c and d-c circuits from 6 to 230 v. Contacts are silver and rated at 10 amp per pole on a resistive load. Contact arrangements are spst, spdt, dpst and dpdt. The unit, with cover and plug type terminals, is 3¼ in. long, 2$\frac{5}{16}$ in. wide and 2$\frac{9}{16}$ in. high.

•

Projection Lightmeter

A PORTABLE PROJECTION lightmeter has been announced by the Meter and Instrument Divisions of the General Electric Co. It flashes light measurements on a screen for easy reading by large audiences.

Designed primarily to simplify the problem of distinguishing between adequate and inadequate lighting, this new lightmeter is model 8PH12 and weighs only 8 lb. The device consists of three major parts—a small, hand-size light-cell probe; a D'Arsonval-type, self-contained microammeter made especially for projection purposes; and a standard SVE 100-w, 2 x 2-in. slide projector.

Normal range of the instrument is 0-100 ft-c; for higher intensities, multiplying masks, which are furnished in 10 and 100 X sizes, must be fitted over the light cell. Additional information is available in Bulletin GEC 265.

•

Brake Shoe Lining

A BRAKE SHOE with a "clamp-on" type lining has been developed by Cutler-Hammer, Inc, 235 North 12th St,

Flat Bars

for SIMPLICITY, ECONOMY and INEXPENSIVE TAP-OFFS

BARS require minimum space, may be bent or twisted, connected to apparatus without special joint preparation and in laminated construction have unlimited d.c. capacity.

TUBES provide the highest bus conductor efficiency at a.c. frequencies, have greater rigidity, and may be oil or water cooled.

CHANNELS have large surface area, reduce temperature rise, provide greater rigidity than tubes for long runs and have flat surfaces for tap-off.

ANGLES for ventilated hollow busses have highest rate of heat dissipation, handle greater current density, but require more space for installation.

CABLES solve many problems in conducting extremely heavy currents in confined space or in connecting moving apparatus such as furnaces of the arc or resistance types.

FLAT BARS require minimum space for making connections to apparatus without the necessity of special joint preparation. The low resistance of the copper and its high thermal conductivity result in low losses and provide an outlet for conducted heat from the apparatus. The bars may easily be bent flatwise or edgewise, or twisted for making the connections.

For heavy currents, due to the large surface area of the laminations, generated heat is readily dissipated. Direct current multi-bar busses have unlimited capacities with adequate copper section and ventilation.

Alternating current busses of flat bars are *limited* in capacity due to unevenness of current distribution in the laminations. 3000 amperes may be considered as the limit of a laminated bus construction for 60 cycles frequency without intricate physical locations of the bars, and without transpositions of the bars.

Anaconda Bus Conductors are available also in four other shapes. Each offers advantages of its own. In addition, because of its high electrical and thermal conductivity, strength, toughness and corrosion resistance, *copper* is recognized as the most satisfactory bus material. Anaconda Publication C-25 contains further information.

47102

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from mine to consumer

Anaconda

BUS CONDUCTORS

THE AMERICAN BRASS COMPANY

General Offices: Waterbury 88, Connecticut

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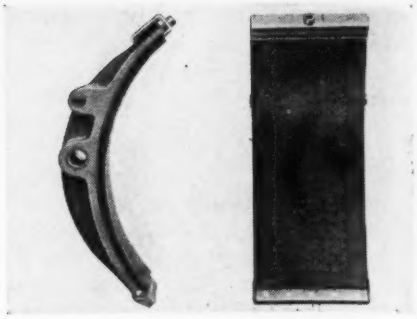
BERMICO FIBRE CONDUIT—A PRODUCT OF BROWN COMPANY



Milwaukee 1, Wis. The non-rivetless lining is folded and compressed asbestos for the line of type M magnetic brakes for mill and heavy duty service.

A vise-type clamp on the brake shoe is said to hold the lining in place and prevent it from shifting in any direction. The clamp consists of a permanent buttress at the lower edge of the shoe with a self-aligning screw jack at the top edge. The lining is placed in the shoe and clamp tightened. That exerts a force on the end of the brake lining, forcing it into the curvature of the shoe and holding it in place. Renewal of this new brake lining is stated to be accomplished without removing the brake shoe, by simply releasing the brake and loosening the single socket headscrew of the jack clamp.

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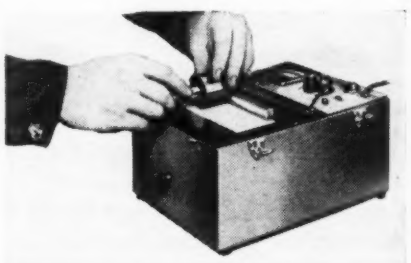


Portable Etcher

FOR ELECTROLYTICAL etching a marking instrument is announced by Crown Industrial Products Co, 1529 East 53rd St, Chicago 15, Ill. Reproduction is said to be made of part numbers, names, or other identifications that can be typed, written or drawn on a 2½x6¾-in. stencil film.

Each film can be used for marking up to several hundred pieces, either round or flat, according to the manufacturer. Etching can be done on alloys, brass, bronze, cadmium, copper, magnesium, tin and zinc. Operation consists of placing the piece to be marked on the film stencil and pressing a button. Switches are provided for continuous operation or single-piece marking.

The unit is portable, has self-contained rheostat and ammeter, weighs 17 lb, measures 9x11x7¾ in. and is available in models for 115 or 230-v a-c operation. Supplies include 24 films, etching fluid, protective fluid, sponges and cloth pads.

Presenting the 1948 edition of the

McGRAW CENTRAL STATION DIRECTORY

This latest, most accurate coverage of changes in electric utility operations and personnel is published for those who work in or sell to the electrical utility industry.

The 1948 edition of the McGraw Central Station Directory lists in one compact volume every discoverable change in the electric utility industry during the past 12 months. Changes in personnel and operations up to April 1, 1948 and other exclusive data on organization, areas served, generation and distribution equipment are included for each of over 4,000 utility plants in the U. S., Canada and U. S. possessions.

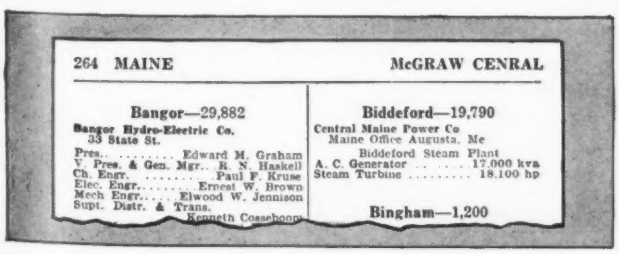
Facts Presented:

1. Names and addresses of private and municipally operated electric light and power companies in the U. S., Canada, and U. S. possessions; also government-controlled projects.

2. Names and addresses of affiliated, holding, controlling or managing and service companies with complete lists of properties controlled or managed by each, and including names and addresses of principal officials.

3. Names and addresses of officials and chief operating men for all operating companies, including:

- Presidents
- Vice Presidents
- General Managers
- Superintendents of Distribution
- Mechanical Engineers
- Commercial or New Business Managers
- Superintendents of Transmission
- Plant Superintendents
- General Superintendents
- Purchasing Agents
- Division or District Superintendents
- Chief Engineers
- Electrical Engineers
- Plant Engineers
- Merchandising Managers
- Division or District Managers



264 MAINE — McGRAW CENRAL

Bangor—29,882
Bangor Hydro-Electric Co.
33 State St.
Pres. ..... Edward M. Graham
V. Pres. & Gen. Mgr.. R. N. Haskell
Ch. Engr. ..... Paul F. Kruse
Elec. Engr..... Ernest W. Brown
Mech. Engr.... Elwood W. Jennison
Supt. Distr. & Trans. Kenneth Cossboom

Biddeford—19,790
Central Maine Power Co
Maine Office Augusta, Me
Biddeford Steam Plant
A. C. Generator ..... 17,000 kva
Steam Turbine ..... 18,100 hp

Bingham—1,200

Sample page of Directory.

REA Co-ops Listed:

REA co-operatives are listed separately in the back of the Directory. This list includes many new co-operatives energized during the past year.

Use by Utilities:

The directory is used by hundreds of utility executives who wish to know about:

1. The organization of other utilities, especially those in their own or adjoining areas.
2. Movements of officials from company to company.
3. Discernible trends in expansions of operations of other utilities.

Use by Manufacturers:

Manufacturers of electrical generating, transmission and distribution equipment, and manufacturers of general equipment and supplies, all serving the vast utility industry, make constant use of the directory for

1. Names and addresses of executive, supervising, managing and engineering officials.
2. Determining electrical characteristics of plant, equipment and lines now in use.
3. Knowledge of scope of operations: generating capacity, towns and number of meters served, etc.
4. For each operating company, the following information is presented:

- Company total and plant individual generating capacity in kva. or kw.
- Kind of prime mover and capacity in hp.
- Amount of power purchased in kw hrs.
- Type of current distributed, No. of wires, phase, voltage and cycle.
- No. of meters served.
- Location of power plants.
- Complete list of towns (of 500 population or over) served.
- A complete alphabetical index of companies listed.

Edition Limited:

Orders will be filled in order of receipt. The Directory is sturdily bound in flexible blue Fabrikoid, fully thumb-indexed, size—4½" x 8½". Price $30.00 per copy. 10% discount on 5 or more copies. For intelligent, productive planning and selling, a copy of the 1948 edition of the McGraw Central Station Directory should be in the hands of every executive responsible for such plans.

Send orders to

McGraw Central Station Directory
McGraw-Hill Publishing Company
330 West 42nd Street, New York 18, N. Y.

NEWS ABOUT PEOPLE

McKee Elected Utility Head; Harsh Made Chairman

Empire District Electric Co, Joplin, Mo., has announced the election of D. C. McKee as president and general manager of the company. James E.

D. C. McKEE

Harsh, chairman of the board, will continue in that position, relinquishing the presidency, a position he has filled for the past eight years, in order to devote more time to the financial side and the

H. E. ROBERTS

broader aspects of the company's operation and development.

Harry E. Roberts, commercial manager and Robert L. Kiddoo, executive assistant, have been elected to vice-presidencies.

R. L. KIDDOO

Mr McKee started in the utility field with the Denver Gas & Electric Co, as a cadet in the Doherty training school. In 1920 he was transferred to the Empire District Electric Co in the engineering department. Subsequently he served as superintendent of the meter department, manager of the power sales department, vice-president and assistant general manager and vice-president and general manager. Mr McKee is a past-president and one of the organizers of the Petroleum Electric Power Association and at the present time is vice-president of the Missouri Valley Electric Association.

Going to Joplin in 1924, Mr Roberts served as district manager and manager of the power sales department, and in 1944 was named commercial manager. He will continue in this capacity and will have direct charge of all industrial and rural development, together with supervision of the company's district offices.

Mr Kiddoo joined the Empire organization in 1935, after several years of association with the Cities Service Co. He has had broad experience in valuation and rate work and has been executive assistant since 1944.

•

▶F. M. HAGEMAN, general manager, electrical engineer and purchasing agent of the municipal light and water plant at St. Marys, Ohio, since 1942, has been appointed superintendent of light, power and water for the municipal light and power department at Portland, Ind.

Schubert Elected President, Wisconsin Utilities Group

William E. Schubert, vice-president and general manager of the Wisconsin Michigan Power Co, Appleton, has been elected president of the Wisconsin Utilities Association. Mr Schubert has been a leader in association activities and in specialized committee work for nearly 25 years.

He held part-time positions in the utility field before entering the employ of Wisconsin Traction, Light, Heat & Power Co, Appleton, in 1923. He became chief engineer of that company and of the Peninsular Power Co in 1925 and the following year when the Wisconsin Michigan Power Co was organized out of the merger of these two

W. E. SCHUBERT

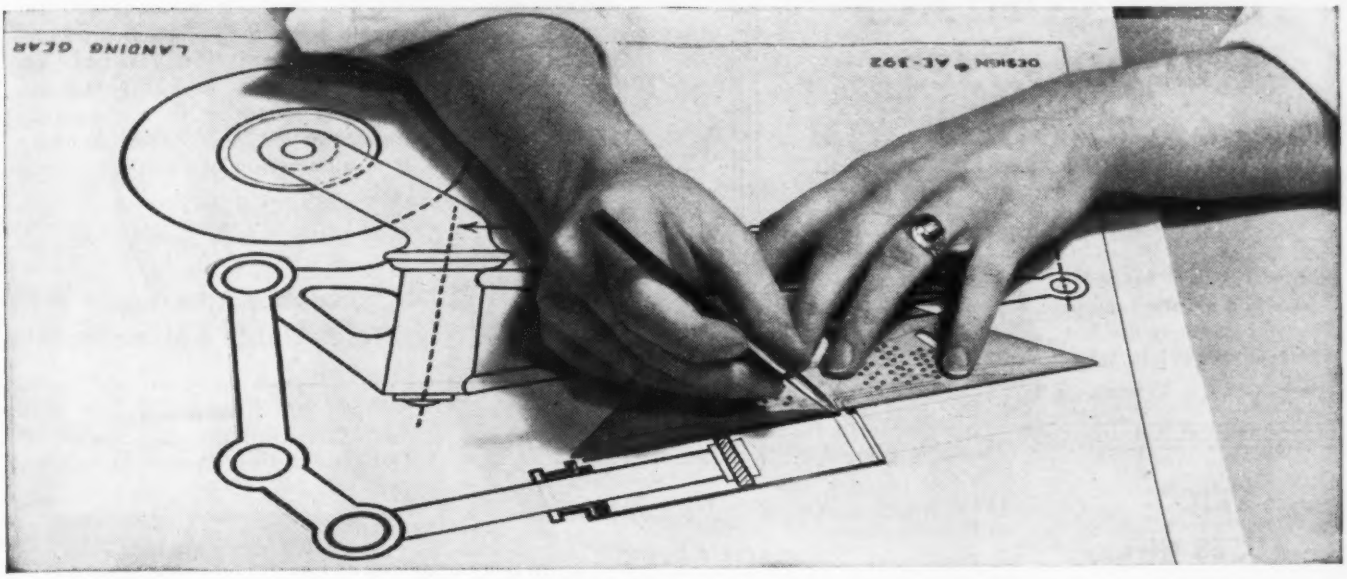
and other companies, he retained the title of chief engineer in the new company.

In 1934 Mr Schubert was appointed assistant general manager, in 1936 general manager and in 1939 vice-president and general manager.

Mr Schubert is a member of the American Society of Mechanical Engineers and of other technical societies.

•

▶JAMES M. WHITE, formerly vice-president in charge of manufacturing at Allis-Chalmers Mfg. Co's Milwaukee plant, has joined the Allen-Bradley Co, also in Milwaukee. As a member of the Allen-Bradley production management staff, Mr White will investigate



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Order an Ozacloth print of your best pencil or ink drawing... and you'll be the first to admit the improvement.

For Ozacloth has characteristics never present in an original drawing... never offered before in an "Intermediate" print:

1. OZACLOTH increases the opacity of pencil and ink images... gives you a translucent "duplicate" which produces better prints than the original.

2. OZACLOTH retains this improved line detail through the years. You have permanent sepia images—no pencil lines to smudge. No ink lines to run. No "surface" images to chip. No loss of opacity or reduction in reprint speed.

3. OZACLOTH resists wear and tear... has a superior tracing cloth base...that's plastic coated...impervious to water, grease, grime. Besides, Ozacloth can be cleaned with a damp cloth in seconds... and its images will not "offset" onto other prints in your files.

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6. OZACLOTH cuts costs! For example, you can make a permanent 8½ x 11 print for 26 cents; a 17 x 22 print for 52 cents. *A fraction of the cost of your original drawing... yet full insurance for years to come!*

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DEPT. NO. 99

OZALID, A Division of General Aniline & Film Corporation, Johnson City, New York

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☐ Please send free sample of new Ozacloth.

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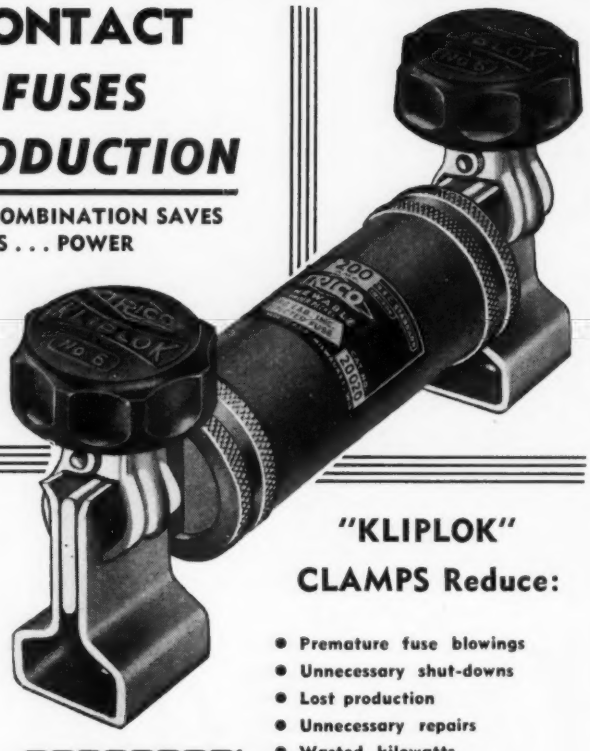
Perfect CONTACT + GOOD FUSES = PEAK PRODUCTION

THIS FAMOUS TRICO COMBINATION SAVES FUSES . . . CLIPS . . . POWER

"Powder-Packed" Renewable Fuses and "Kliplok" clamps insure Peak Production and THREE TIMES THE SERVICE.



TRICO FUSES Give:

- Guaranteed results
- Tamper-proof protection
- Low-resistance contacts
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- Life-time outer parts
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"KLIPLOK" CLAMPS Reduce:

- Premature fuse blowings
- Unnecessary shut-downs
- Lost production
- Unnecessary repairs
- Wasted kilowatts
- Fire & accident hazards
- "Doubling-up" fuse links

WRITE FOR BULLETINS NO. 1 AND 6

TRICO FUSE MFG. CO. Milwaukee Wisconsin FUSES

SCIENTIFIC WIRE STRINGING *Paid Off*

When temperatures drop, wires tighten up unmercifully. This was demonstrated repeatedly last winter when sub-zero weather caused wires to snap, and too-tight wires combined with heavy sleet and ice to bring many poles to the ground.

Some spans stayed up beautifully in the worst ice, sleet and wind of the season. They were the wires strung with Dillon Dynamometers to exact tensions recommended by the wire manufacturers. They were the ones where the relatively small cost of scientific wire stringing paid off.

As insurance against the next bad storms, check all guy and conductor tensions with Dillon Dynamometers. It isn't necessary to cut the wire. Above all, string all new wires the safe, scientific way.

The Dillon Dynamometer was created expressly for wire stringing. It's light in weight, compact and easy to use. Can be worked with a rope block, chain hoist or truck winch. It's dead accurate.

Dillon DYNAMOMETER

TO GET YOUR *free* COPY

of the "Rules of Successful Wire Pre-Stretching and Stringing," written by experienced linemen, drop us a note today.

W. C. Dillon & Co., Inc.

5407 W. HARRISON ST., CHICAGO 44, ILL.

cost and inventory methods and participate in handling production management problems. He has had long experience with works management problems, advancing from student apprentice in 1929 to executive in charge of manufacturing of all A-C plants in 1941.

•

U.S. Rubber Announces New Wire-Cable Appointments

Announcement has been made by the United States Rubber Co, New York, of the appointment of Howard H. Weber as chief engineer of the wire and

H. H. WEBER

cable department, and of A. S. Basil as general sales manager of that department. Mr Basil has been associated

A. S. BASIL

with the company since 1926 and Mr Weber since 1934. Both men have had wide experience in electrical sales and engineering.

Other changes announced by C. W. Higbee, manager of the department, are as follows:

H. J. MacDonald, assistant to the manager; H. F. Johnson, assistant general sales manager; R. A. Walker,

THE ANTIMONIAL ADMIRALTY THAT'S TESTED BY TIME IS PATENTED BY CHASE

SINCE 1935 the resistance of Chase Antimonial Admiralty Condenser Tubes to dezincification has been remarkable. Why? Because Chase-patented admiralty has always contained more than the minimum amount of antimony to give protection against the escape of zinc.

Experience has shown that once the antimonial content goes below .007% (the minimum set forth in Chase Patent No. 2,061,921) there is relatively little protection. Chase's admiralty contains a nominal amount of 0.035% antimony to allow for commercial variation sometimes encountered. This assures you of an antimonial content of about .015% —the minimum necessary for reasonably complete protection. *That's why it pays to insist on Chase Antimonial Admiralty. Write today.*

Special stocks of ANTIMONIAL ADMIRALTY Condenser Tubes in Chase Warehouses at BALTIMORE, NEW ORLEANS LOS ANGELES, SAN FRANCISCO also carried by— Vinson Supply Co., TULSA Standard Brass & Mfg. Co. HOUSTON

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the Nation's Headquarters for BRASS & COPPER

SUBSIDIARY OF KENNECOTT COPPER CORPORATION

THIS IS THE CHASE NETWORK . . . *handiest way to buy brass*

ALBANY† ATLANTA BALTIMORE BOSTON CHICAGO CINCINNATI CLEVELAND DETROIT HOUSTON† INDIANAPOLIS KANSAS CITY, MO. LOS ANGELES MILWAUKEE MINNEAPOLIS NEWARK NEW ORLEANS NEW YORK PHILADELPHIA PITTSBURGH PROVIDENCE ROCHESTER† SAN FRANCISCO SEATTLE ST. LOUIS WATERBURY (†indicates Sales Office Only)

North • East • South • West . . . It's Schramm

. . . doing jobs like these in Your Field

At almost every turn you need compressed air!

The check list (at right) indicates some of the many compressed air jobs to be done, all of which are accomplished easily, quickly and economically with Schramm Air Compressors.

Here's *why* you profit, as others have, by using Schramm: they're compact, lightweight, easy to start; built for rugged jobs, to provide a continuous flow of air.

Important features include 100% water cooled; mechanical intake valve; forced feed lubrication and easy, electric push-button starting.

Performance everywhere has proved Schramm Air Compressors can do any compressed air job you require. Write today for list of models and sizes.

- Rock Drilling
- Breaking Pavement
- Trench Digging
- Clay Spading
- Sheet Pile Driving
- Backfill Tamping
- Caulking Pipe Lines
- Spray Painting
- Sand Blasting
- Digging Post Holes
- Pneumatic Grease Guns
- Pneumatic Tools
- Spraying Metal
- Spraying Enamel
- Riveting
- Steel Drilling
- Wood Boring
- Scaling
- Chipping
- Caulking Boilers
- Cleaning Boiler Flues
- Cleaning Engine Generators
- Operating Air Hoists

SCHRAMM INC.

THE COMPRESSOR PEOPLE • WEST CHESTER • PENNSYLVANIA

merchandise manager; J. A. Leuver, assistant sales manager in charge of distribution; D. B. Karlskind, assistant sales manager in charge of commodities, sales engineering and new projects; G. E. Hubrig, sales manager, western division; C. A. Bartron, chief sales engineer; A. E. Aune, manager, automotive and aircraft wire sales, and R. C. Cassiday, manager, Uskon sales.

•

▶ STANLEY A. TUCKER, formerly managing editor of ELECTRICAL WORLD, has been appointed to head the standards department of the American Society of Mechanical Engineers, which handles programs of ASME boiler construction code, power test codes, safety codes, and development of dimensional standards under procedure of American Standards Association. Mr Tucker brings to ASME more than 10 years of editorial experience on the staffs of *Power*, another McGraw-Hill publication, *McGraw-Hill World News* and ELECTRICAL WORLD. His earlier activities included power plant design and construction for the Hudson Av. station of Brooklyn Edison Co.

▶ STANLEY H. YOUNG has been appointed safety engineer of the Hartford Electric Light Co. He succeeds JUSTIN H. AHRENS, recently appointed an industrial power consultant of the company. Mr Young was graduated as an electrical engineer from Rensselaer Polytechnic Institute in 1923. After a year in city engineering work he joined the Hartford company and has since filled various posts in the distribution department.

▶ C. HAMILTON MOSES, president of the Arkansas Power & Light Co, Little Rock, was named as the outstanding citizen of the state during the past year by the Arkansas Junior Chamber of Commerce at its annual convention held recently in Hot Springs.

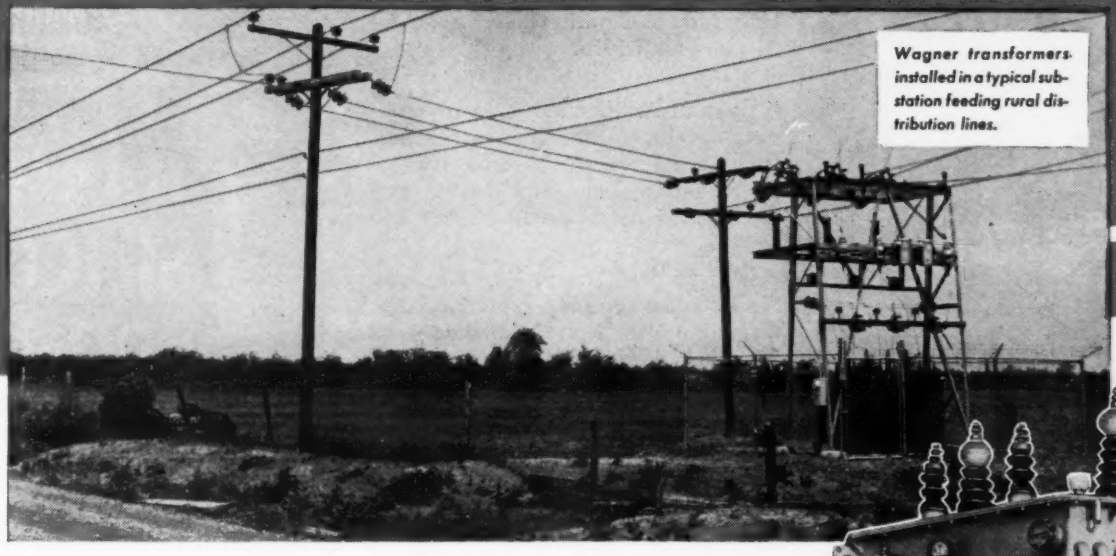
▶ F. HARVEY SEARIGHT, for 37 years associated with Allis-Chalmers Manufacturing Co on the west coast, has retired. Mr Searight, who joined A-C in 1911, served successively as sales representative, assistant manager, manager of the San Francisco district office, and for the past nine months as Pacific region sawmill specialist.

OBITUARY

▶ WILLIAM A. COOLIDGE, safety engineer of the Boston Edison Co, died suddenly on May 7 at Lexington, Mass. He was born in Cambridge, Mass., in 1884. He joined the Edison com-

THEY'RE PART OF THE PICTURE...

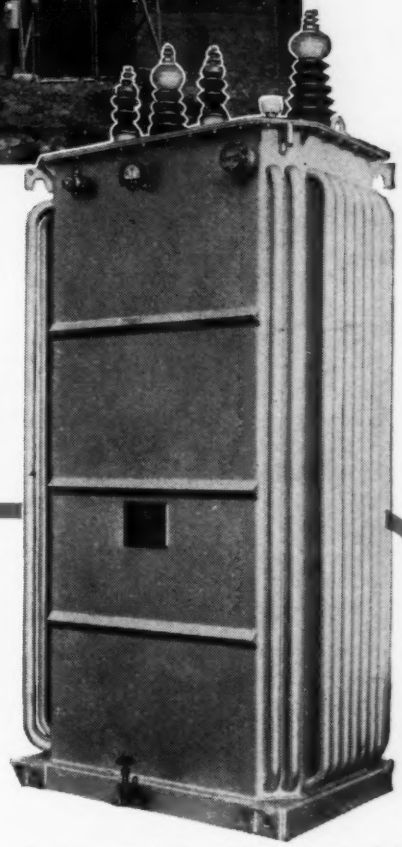
Wagner Substation Transformers for RURAL APPLICATION

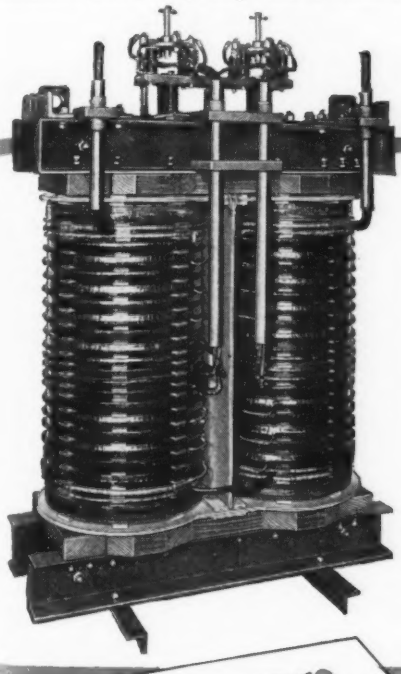


Wagner transformers installed in a typical substation feeding rural distribution lines.

WAGNER builds a complete line of oil-filled, self-cooled transformers for substation operation on distribution systems. Hundreds of these transformers are supplying many of the rural-line systems in operation throughout the country. They are available in all standard kva and voltage ratings with standard accessories.

Wagner transformers are nationally known for their high standard of quality and performance based on a background of a half-century of designing and building distribution and power transformers. Trained field engineers in our 29 branch offices, located in principal cities, are ready to help solve your Rural-Line Transformer problems.





Pictured at right is a 500 kva 46000 to 7200 volt, type HEL transformer. These units are available in sizes 150 to 500 kva in standard voltage combinations up to 69 kv.

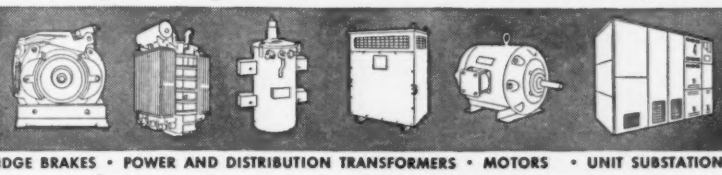
The element, shown at left, is a typical core-type element, like those generally used in transformers of this classification. Note its simple design and sturdy construction . . . built for years of rugged service.

Bulletins TU-180 and TU-181 give full information on Wagner Substation Transformers. Write for your copies.

Wagner Electric Corporation
6456 PLYMOUTH AVE., ST. LOUIS 14, MO., U.S.A.

Wagner Electric Corporation EST. WE 1891

Consult Wagner Engineers on All Transformer Problems

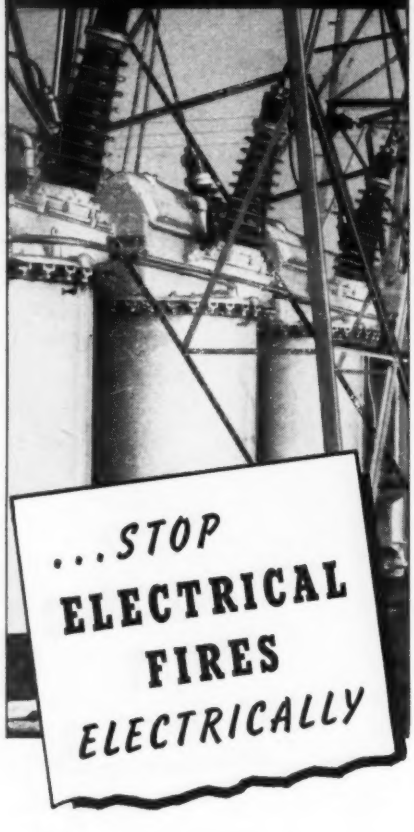


BRIDGE BRAKES • POWER AND DISTRIBUTION TRANSFORMERS • MOTORS • UNIT SUBSTATIONS

ELECTRICAL AND AUTOMOTIVE PRODUCTS

T48-10

BLAW-KNOX
FIRE PROTECTION SYSTEMS



Blaw-Knox electro-thermostatically controlled fire protection systems *act instantly*. They respond to either abnormal rate of rise in temperature or to temperature above a fixed maximum. Valves, alarms, fire pumps, and other protective devices are activated *with the speed of electricity.*

Blaw-Knox Fog Nozzles are especially adapted to, and approved for, protection of transformer banks and similar installations.

Blaw-Knox Fire Protection Equipment is listed by Underwriters Laboratories, Inc. and approved by Factory Mutual Laboratories.

When writing, ask for Bulletin No. 2207

BLAW-KNOX
SPRINKLER DIVISION
of Blaw-Knox Construction Company
829 Beaver Avenue, N. S.
Pittsburgh 12, Pa.
Offices in Principal Cities

pany in 1902. Mr Coolidge was widely known in the safety engineering field in northeastern electrical and industrial circles.

▶ ROY L. ZINSTINE, formerly safety director of the Ohio Edison Co, died suddenly on April 22 in Youngstown. He was 48 years old. Mr Zinstine had been identified with Ohio Edison for 25 years until 1946.

▶ EMBURY A. HITCHCOCK, dean emeritus of the college of engineering, Ohio State University, died on April 29 in Columbus, Ohio. He was 81 years old. He retired as dean in 1936.

▶ WALTER R. CHITTY, 42, Edmonds, Wash., branch manager of the Puget Sound Power & Light Co, died on April 23. He had been manager of branches at Skykomish, Sultan and Snohomish before taking the Edmonds position six years ago.

▶ SEARLE F. THOMAS, 60, a partner in the Seattle, Wash., refrigeration machinery company of W. E. Stone & Co, died April 26. An electrical engineering graduate of the University of Maine, he had been with the Stone company since 1926. He was a charter member of the National Association of Practical Refrigeration Engineers, the Pacific Northwest chapter of the American Society of Refrigerating Engineers and the Refrigeration Contractors' Association of America.

▶ SWEN W. NELSON, manager Buffalo office, Bailey Meter Co, Cleveland, died suddenly on April 12. Mr Nelson joined Bailey Meter shortly after its founding. Returning to the organization in 1919 after service in World War I, he was assigned to the Cleveland plant and in 1921 was transferred to the Buffalo branch office as a sales-service engineer. In 1923 Mr Nelson was appointed branch manager of the Buffalo office.

▶ HERMAN W. BIEBEL, electrical engineer and patent engineer for the Westinghouse Electric Corp, Pittsburgh, from 1908 to 1935, and later a patent engineer for the McGraw Electric Co, Elgin, Ill., until his retirement in 1947, died on April 23 at Tucson, Ariz., where he had been spending the winter.

▶ JOHN W. RUFF, formerly Barnwell manager for the South Carolina Power Co, died on March 4 at his residence in that city. He had retired as utility manager about 18 months ago and since that time had been doing industrial research work for the company in the Barnwell area.

STOP SEASON CRACKING AND CORROSION

with
HARPER SILICON BRONZE fastenings

Power companies throughout America are using Harper silicon bronze fastenings to help avoid power failures . . . and to end maintenance and replacement costs. These fastenings withstand extremes of temperatures . . . season cracking . . . atmospheric and other corrosion . . . in both overhead and underground construction . . . and now that modern treating has increased pole life so greatly, there are added savings in using fastenings that do not have to be replaced.

OVER 5000 STOCK ITEMS

. . . of nonferrous and stainless fastenings for immediate shipment . . . brass, bronze, copper, Monel metal and stainless steel bolts, nuts, screws, washers, rivets, nails. Many items are rare and hard to get . . . not stocked elsewhere. Write for the Harper catalog.

THE H. M. HARPER COMPANY
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HARPER
Everlasting Fastenings
Chicago • New York

REPORT ON A VAST UNDERTAKING IN PUBLIC SERVICE

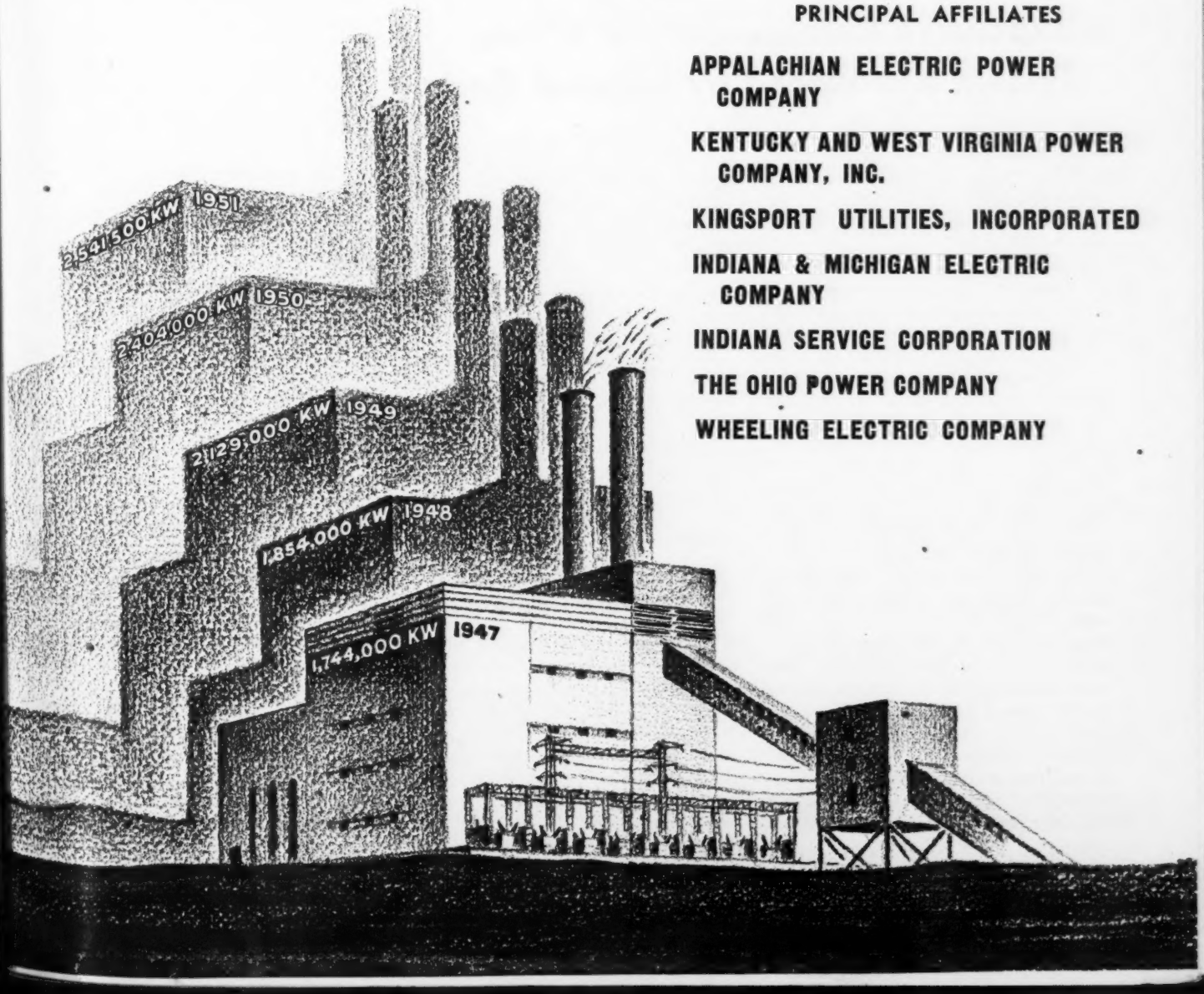
AT THE beginning of the war, the companies in the system of the American Gas and Electric Company had ample capacity for customer requirements and adequate reserves for emergencies. In the war years between 1939 and 1945, these companies constructed over 900,000 kilowatts of capacity — every kilowatt that Government restrictions would permit. During all of that period, the system power supply to sustain the stupendous war effort was always adequate and on time.

The extraordinary upsurge in demand for power that developed shortly after the end of the war required a revaluation of probabilities and in 1947, the company announced a vast program of extension to its facilities which will ultimately cost $265,000,000.

Broad expansion of the interconnected transmission system is contemplated in the program and additions to steam generating facilities are proceeding as rapidly as the units can be manufactured.

A new 110,000 kw turbine will be in operation in the Tidd Plant at Brilliant, Ohio, by midsummer. The capacity of the Twin Branch Plant at Mishawaka, Indiana, will be increased by 137,000 kw in May, 1949. In July, 1949, a 137,000 kw unit in the Philip Sporn Plant at Graham Station, West Virginia, is scheduled to go on the line — and two additional units, each of 137,000 kw capacity are proposed. The first of these will be completed in June, 1950, and the second is planned for completion in July, 1951. Land has been purchased on the Ohio River in southern Indiana for another new plant to be in operation in December, 1950, which initially will have a capacity of 137,000 kw. With these additions completed, the system capacity will be in excess of two and a half million kilowatts.

AMERICAN GAS AND ELECTRIC COMPANY



PRINCIPAL AFFILIATES

APPALACHIAN ELECTRIC POWER COMPANY

KENTUCKY AND WEST VIRGINIA POWER COMPANY, INC.

KINGSPORT UTILITIES, INCORPORATED

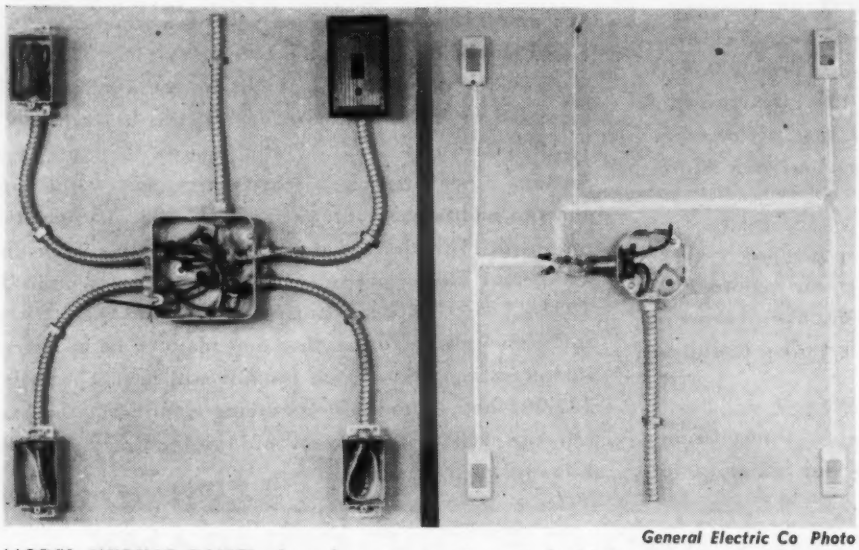
INDIANA & MICHIGAN ELECTRIC COMPANY

INDIANA SERVICE CORPORATION

THE OHIO POWER COMPANY

WHEELING ELECTRIC COMPANY

MANUFACTURERS and MARKETS



General Electric Co Photo

MODEL WIRING PANEL shows how new remote control wiring system (right) eliminates the need for much of the large special equipment required in conventional wiring at left

Inexpensive Remote-Control Wiring System Announced by General Electric

A new remote-control wiring system which makes possible a completely new and more flexible method of controlling lights and outlets in the home, office, or factory has been announced by the General Electric Co.

Incorporating a new line of wiring materials, the system eliminates much large and expensive material, and, at low cost, greatly extends the uses and convenience of the wiring in all types of buildings. The system is also safer. Because it operates in part at 25 v, the system is not subject to the same code restrictions as the conventional system. Installation is simplified. The system can be short-circuited at any point without danger of excessive heat or fire.

Principal advantage of the remote control system is that it permits one to switch on lights, outlets, or small appliances from any number of points within the building. Any outlet can economically be controlled from as many as four or more switches. The more switches, the cheaper the remote control system becomes. It will still be cheaper to install a conventional wiring system to control one, two, or more lights from a single switch.

Easy to install either in new or old buildings, the new GE wiring system differs from the conventional system in that the switches are connected to the outlets which they control by a new light-weight Flamenol-insulated 22-gage wire carrying only 25 v. Finger pressure on the 25-v switches activates 25-v relays mounted at the lights or outlets. The relays, in turn, turn the lights on or off. A small transformer in the building provides the low voltage.

All five components of the system are now in production. The five components are one type of switch, one type of switch box, one type of relay, two types of wire, and one type of transformer. All components except the transformer are new GE developments introduced coincidentally with the remote control system.

•

Carrier Forms Subsidary

To serve South Africa and adjacent territories, the Carrier Corp, Syracuse, has formed Carrier Africa, Ltd, a subsidiary company with headquarters in Johannesburg, Union of South Africa. Ralph S. Reynolds, who has been associated with Carrier for 19 years, has been named general manager of the new organization.

Pennsylvania Plant Bought by Westinghouse Corp

Purchase of additional manufacturing facilities in western Pennsylvania near Irwin, as part of a $132,000,000 long-range expansion and improvement program, has been announced by the Westinghouse Electric Corp.

T. I. Phillips, vice-president in charge of the East Pittsburgh divisions, said the purchase consisted of 20 acres of land and four three-story buildings at Hahntown, two miles south of Irwin. The property was formerly owned by the General Foods Corp and occupied by one of its divisions. Purchase price was not announced.

The four buildings are all connected and provide 125,000 sq ft of floor space. They will be occupied by the mica-processing section of the transportation and generator division, formerly located at East Pittsburgh.

It is anticipated that most employees now working on mica production at East Pittsburgh gradually will be absorbed in other expanded operations there, Mr Phillips said. The new facilities near Irwin will provide employment for an additional 250 to 300 persons when in full operation.

•

Birkel Electric Bought by J. F. and J. S. NePage

The Birkel Electric Co, Seattle, Wash., has been purchased by J. F. NePage and his son, John S. NePage, who will continue operating under the Birkel name for the time being, but eventually will change over to the name of the NePage Electrical Supply Co.

The electrical contracting and construction department will be expanded as rapidly as possible under John S. NePage and eventually will be operated under the name of NePage Electric Co. The fixture division also will be enlarged and the retail store, repair department and appliance division will be continued.

Birkel Electric has been in business for 35 years. J. F. NePage organized the NePage-McKenny Co in 1911 and supervised electrical installations in many large buildings on the Pacific Coast. The company maintained offices

Silver DEPOSITS ON BUSES AND SWITCH GEAR

INDUSTRIAL BRUSH ELECTRO-PLATING

is a low-cost, efficient and practical method of applying permanent pure silver* deposits on electrical equipment.

Economy: This original Brush Plating process applies the finest plating possible. Electrodeposits are applied only where the applicator is used. Plating costs can be reduced and placed under complete control.

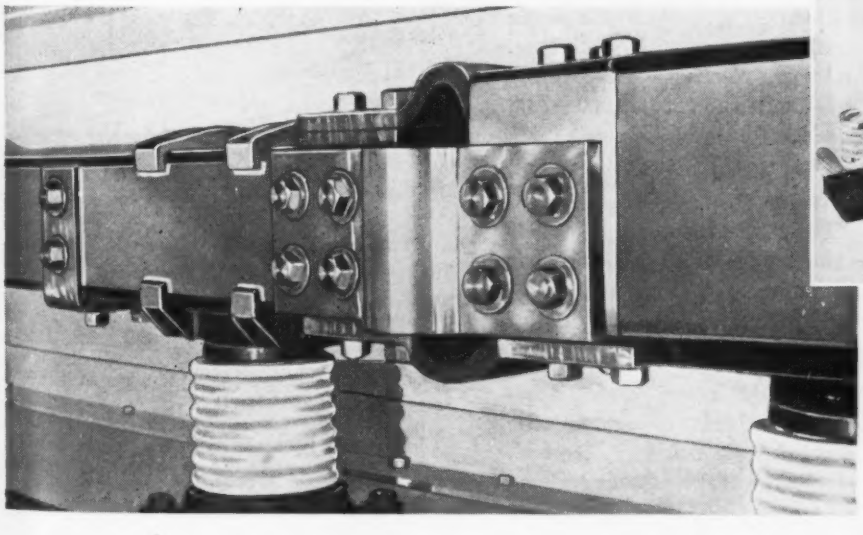
Availability: The efficient power unit and solutions are always ready for instant use — anywhere. Use it on equipment "in place" or during manufacture — No service interruptions.

Simplicity: An average worker will learn the correct method of use in less than thirty minutes.

*The electrodeposits of this process are 99.9% plus, pure silver.

- **Brush Electroplating permits rehabilitation of obsolete equipment**
- **insures positive protection to strategic metals**
- **eliminates destructive oxidation**
- **pure silver gives greater electrical conductivity**
- **helps prevent loss of power**
- **gives longer and more satisfactory performance to present electrical equipment**
- **approved and used extensively by United States Army and Navy — Industrial plants and most Power Companies**

*Also applicable for other metals, gold cadmium, zinc, nickel, tin, etc.



NEW LOW group price for complete outfit ready for use as illustrated, only $189.50, f.o.b. Chicago. Brushes are made of Nylon bristles and are unaffected by normal plating solutions. The above installation is all you need for this modern electroplating process.

AJAX-CONSOLIDATED COMPANY

Service to Utilities . . . Industry and Railroads

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CARLOADS OF BLANKET PROFIT OPPORTUNITIES

. . . if you hop aboard NOW!

This, Mr. Utility Man, is a real gravy train for *you!*

It's a General Electric Automatic Blanket Plan that'll mean extra profits, extra sales, extra off-peak load. But to take *full* advantage, you've got to act, *quick!*

First—Your General Electric distributor has been granted a special price on carload shipments (1512 units) of G-E Automatic Blankets. Your investment is less, your profits *go up!*

Second—An *extra-special* price if your carload order, through G-E distributor, for summer delivery (June, July, and August) *reaches us by June 15.*

And this means *more* than profits.

It means ample stocks for fall and winter selling, when demands for General Electric's marvelous Automatic Sleeping Comfort will be soaring. (Last year, electrical bed-covering sales amounted to $23,000,000 retail. This year's total will be more.)

It means extra load for your midnight-to-morning, *off-peak* hours, too. Two G-E Automatic Blankets equal one refrigerator in kilowatt hour consumption.

Get in touch with your General Electric distributor, *right now.*

Get in on this money-making Automatic Blanket plan! General Electric Company, Appliance and Merchandise Department, Bridgeport 2, Conn.

Automatic Blankets

"Covering Sleep-Happy America"

GENERAL ELECTRIC

and warehouses in Seattle, Spokane, Great Falls, Vancouver, B. C., Portland, Ore., San Francisco and Oakland. John S. NePage is an electrical engineering graduate of the University of Washington.

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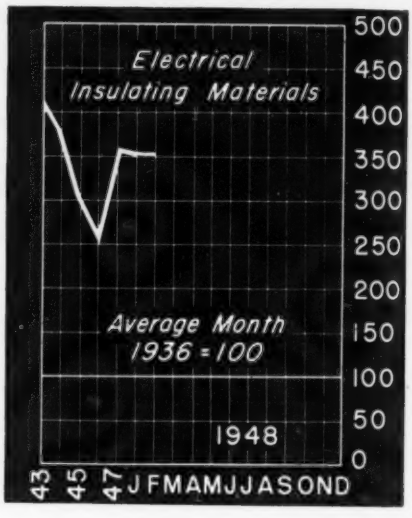
Insulating Materials Sales Dropped 1% in February

Sales billed on electrical insulating materials during the month of February 1948 dropped slightly from the January



total, according to the index compiled by the National Electrical Manufacturers Association. The index dipped to 351 from 353 (revised).

In February 1947, the index stood at 373, this year's figure representing a decrease of 6%.

•

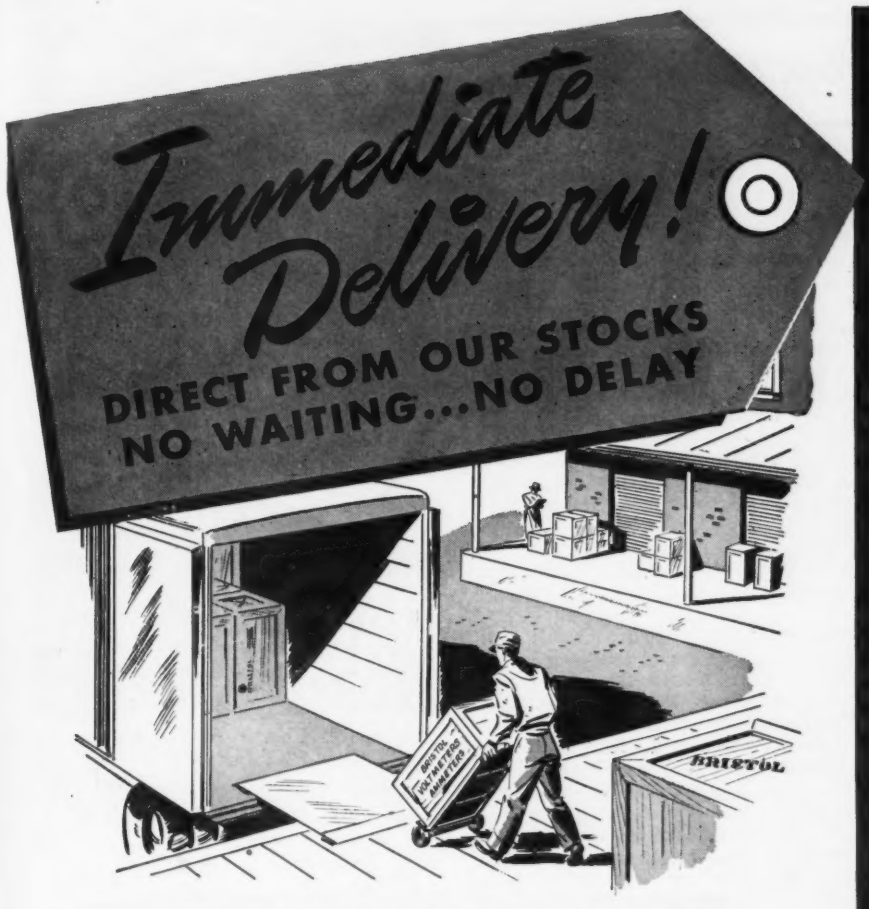
Manufacturers Make New Sales Assignments

Electrical manufacturing companies have recently made the following appointments to their sales staffs:

Allen-Bradley Co, Milwaukee, has announced that their Florida representative, Ward Engineering Co, Inc, Jacksonville, has opened an additional office at 1217 W Central Av, Orlando.

Proctor Electric Co, New York, has appointed A. D. McClenaghan Hartford district manager. Formerly the Harrisburg, Pa., district manager for the company, Mr McClenaghan's new territory will embrace the states of Connecticut and Vermont and parts of New York and Massachusetts.

Oliver Iron & Steel Corp, Pittsburgh, has appointed G. M. Daly northeastern district manager of its pole line hardware division with headquarters at 50 Church St, New York. Mr Daly will supervise sales activities in the entire northeastern territory, including the New England and Middle Atlantic states and Virginia. He was formerly pole line district sales representative in New York.



BRISTOL RECORDING VOLTMETERS AND AMMETERS
Equipped with 8" charts, black moisture-proof cases. Chart drives as indicated.

RECORDING VOLTMETERS

Wall And Switch Board Model 540M

RANGE	CHART DRIVE	CONNECTION
90-130 volts	24 hr. spring or electric	back or bottom
90-140 volts	7 day electric	back
100-135 volts	7 day electric	back

Portable Model 522MSP*

90-130 volts	24 hr. spring or electric	side
90-130 / 180-260 volts	24 hr. spring or electric	side
90-140 / 180-280 volts	24 hr. electric	side

RECORDING AMMETERS

Wall And Switch Board Model 640M

RANGE	CHART DRIVE	CONNECTION
0-5 amps	24 hr. spring or electric	bottom
0-5 amps	7 day electric	back

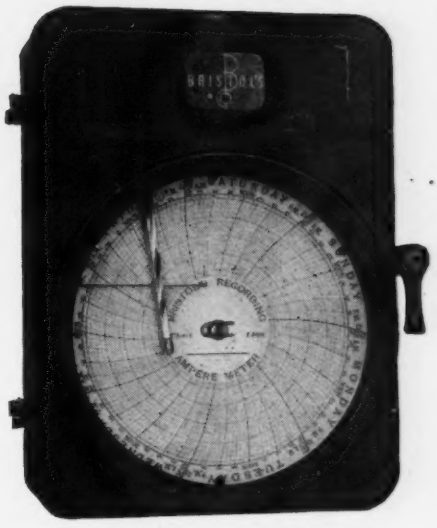
Portable Model 622MP* and 622M

0-5 amps (622MP)	24 hr. spring	side
0-5 amps (622M)	24 hr. spring	side

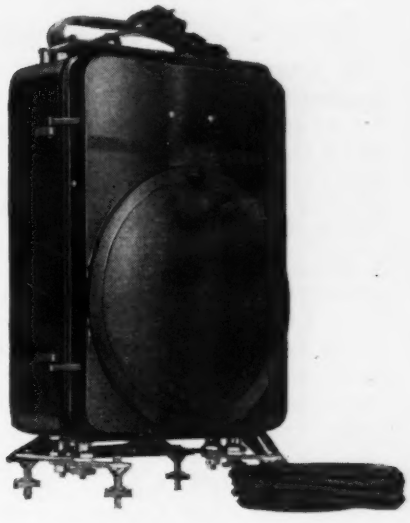
*Equipped with weather-proof portable case and adjustable lugs for mounting on wall or pole. 622M similar, but not designed for wall or pole mounting.

IMMEDIATE DELIVERY

Bristol has hundreds of recording and controlling instruments as well as pyrometers and thermocouples *in stock* for immediate delivery. Send for Bulletin W1811 Stock Instruments and Bulletin P1235, Thermocouples and Pyrometer accessories.



Bristol Recording Ammeter, Model 640M



Bristol Portable Recording Voltmeter, Model 522MSP

THE BRISTOL COMPANY, 116 Bristol Road, Waterbury 91, Conn. (The Bristol Company of Canada, Ltd., Toronto, Ontario. Bristol's Instrument Co., Ltd., London N. W. 10, England.)

Engineers process control for better products and profits

AUTOMATIC CONTROLLING AND RECORDING INSTRUMENTS

Where and How to Use *Crapo* Steel Conductor

Ask for This Guide to Low-Cost Rural Lines!

If future plans call for the extension of rural service, be sure to ask for a copy of this Manual! A study of its contents will show where and how *Crapo* Steel Conductors can be used to profitable advantage in rural distribution systems.

This illustrated book contains pertinent data on the electrical characteristics and electrical performance of these unique conductors. It shows how construction costs can be reduced by the use of long spans, gives initial and final sag and tension data, describes construction practices, cites typical installations.

Crapo **Steel Conductors are especially applicable to rural taps and branches where construction and maintenance costs are important considerations. The experience of a number of leading utilities over a period of years shows conclusively that *Crapo* Steel Conductors are giving dependable, economical and efficient service on thousands of miles of line in rural areas.**

Crapo **Steel Conductors are distributed by Graybar Electric Company, Inc. Ask a Graybar representative for a copy of the *Crapo* Steel Conductor Manual or write direct for Manual No. 110-C.**

Indiana Steel & Wire Company
Muncie, Indiana

Crapo
Steel Conductors

Recent Rate Changes

CENTRAL MAINE POWER Co has filed a schedule of rate increases with the state public utilities commission. President W. F. Wyman informed the board that no general rate increases have occurred on the system for 30 years. Tax and other operating costs now force the company to advance its tariffs. The total increase for all classes of customers is estimated at $1,143,000 for a year. With minor exceptions electric service will cost residential, rural and farm customers from 1 to 1.5 cents per day more than before. Gas rates will go up $86,440. In the past five years, wages have risen from $3,386,798 to $4,340,947; coal has gone from $6.50 to $10.33 per ton; oil from $1.65 to $3.04 per barrel; state and municipal taxes from $1,207,353 to $1,474,996. Construction costs have risen over 50 percent.

CAROLINA POWER & LIGHT Co has won the right to put through a rate increase for its large industrial customers, but not as much of an increase as the company had sought. The utility asked for a fuel clause increase for every 10 cents increase in coal above $6 a ton. The commission facing objections to the increase by 22 textile mills, pegged the base coal price at $7 a ton and allowed an increase of .0065 mills per kilowatt-hour for each 10 cents in cost of coal above $7 a ton. This will apply to industrial customers using more than 15,000 kwhr per month. It is estimated that gross revenue will increase about $458,000 a year and net about $247,000. Under the rates asked by the utility, gross would have increased $858,000 and net by $470,000.

ELKO-LAMOILLE POWER Co, Elko, Nev., has received commission approval for a new rate schedule, reducing rates $25,000 annually in the Elko area. J. G. Allard, chairman of the commission, stated the reduction was based on a study of the 1947 profits earned by the company, which indicated that the rate of return on the utility's investment appeared "top-heavy." The reduction was to go into effect with the March billings. An average saving of $9 a month will be realized by the utility's customers in the area, Chairman Allard said.

ALEXANDRIA (LA.) CITY COUNCIL has voted a reduction in electric power rates to small commercial customers of the municipal power and light department. The ordnance also carried an adjustment in the additional charge now being made for electric service for customers living outside of the city limits. The minimum charge for single phase domestic service was set at $1.60 inside city limits and $2 outside for each residence or apartment.

•

'Sylvania' not 'Wabash'

Wabash-Sylvania photolamps, including the Electroflash, will be marketed in the future under the name, "Sylvania," only. The Wabash Corp was acquired two years ago by Sylvania Electric Products, Inc. The Wabash Corp will continue to operate as an independent subsidiary.

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Palnut Self - Locking Nuts are inexpensive single thread, tempered spring steel locknuts — easily, speedily spun on top of regular nuts with the fingers, locked tight with a wrench.

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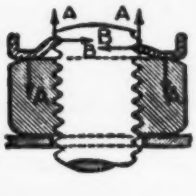
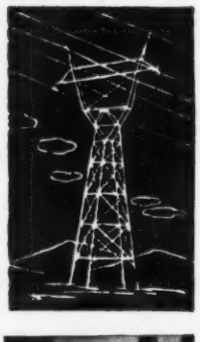
Arched, slotted jaws grip the bolt like a chuck (B-B), while spring tension is exerted upward on the bolt threads and downward on the regular nut (A-A), securely locking both.





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Specify "Palnuts" on new lines—add "Palnuts" to existing lines, without disturbing regular nut. Eliminate further re-tightening and checkups. Hot Dip Galvanized finish, in all utility sizes.

PALNUTS for terminal connections

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• Send details of needs for samples and information on "Palnut" Self-Locking Nuts.

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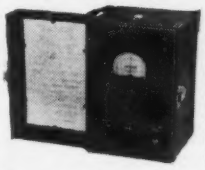
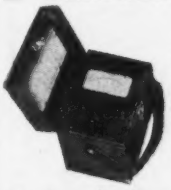
☐ **Measuring resistance to earth of protective grounds.**



VIBROGROUND

in two models (4 and 3 ranges) is unaffected by stray AC or DC currents. Meets A.R.A.; A.I.E.E. specifications. Self-contained, portable, no leveling or cranking

☐ **Insulation resistance testing.**



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36 models. Self-contained, portable, no leveling or cranking. Push button operation, with safety features incorporated. Accurate from —40 to +140 degrees F.

☐ **Insulation breakdown testing.**

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discriminates between leakage breakdown and short. Voltage variable from 0 to 4000 volts AC. Fully grounded, portable, self-contained. Reads actual secondary voltage applied. Red light warns when energized. Shielded leads.

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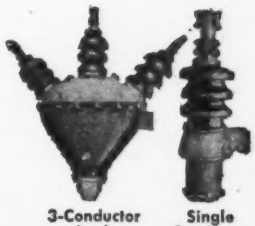

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NEW ELECTRICAL CONSTRUCTION

NEW ELECTRICAL construction projects announced by private and government utility systems involving more than $70,000. Also listed are major industrial and construction jobs where electrical work is included

UTILITIES

Proposed Construction

Arizona and California — Bureau Reclamation, Dpt. Interior, Bldg. 1A, Denver Federal Center, Denver, Colo., furnishing carrier-current telephone transmitter-receiver sets, coaxial carrier-frequency cable, coupling capacitors, carrier-current line traps, for Davis Dam Project, at Phoenix, Maricopa, Heaton, Tucson, Coolidge, Yuma, Kingman, and Prescott, Ariz., Earp and Blythe, Calif., Spec. 2176. W. R. Young, Bldg. 1A, Denver Federal Center, Denver, Colo., ch. engr.

California — Bureau Reclamation, Dpt. Interior, Bldg. 1A, Denver Federal Center, Denver, Colo., three 196,000-volt-insulated 300/600- to 5- and 5-ampere, double-primary and individual double-secondary, oil-immersed, self-cooled, outdoor current transformers for Davis No. 1 line at Parker 230-kilovolt switchyard, Davis Dam Project, Earp, Spec. 2241. Plans deposit $1. W. R. Young, Bldg. 1A, Denver Federal Center, Denver, Colo., ch. engr.

Calif., Stockton — State Div. Architecture, Pub. Wks. Bldg., Sacramento, electrical distr. sys. for Stockton State Hospital, Anson Boyd, Sacramento, State archt.

Colorado — Bureau Reclamation, Dpt. Interior, Bldg. 1-A, Denver Federal Center, Denver, Colo., furnishing, del. f.o.b. cars shipping point, or f.o.b. cars Loveland, switchgear assembly, transformers, induction voltage regulators with 100-kva transformers, for installation at Estes Power Plant, Colorado-Big Thompson Proj., Spec. 2245, Plans deposit $1.50. Walker R. Young, Denver, ch. engr.

Ind., Columbia City—Bd. P. Wks., F. Dillman, secy., municipal power plant, imprvs., incl. piping, turbine instruments, combustion control, water softening, boiler setting. **$206,000.** Douglas & Laramore, 327 S. LaSalle St., Chicago, Ill., consult. engrs.

Ind., Fort Wayne—Bd. P. Wks., Walter C. Vetter, chn., Fort Wayne, 10,000 kw. turbine, condenser, switchgear, feed water heater, pumps at municipal light plant. $750,000. Emery, Marker & Emery, Toledo Trust Bldg., Toledo, O., engrs.

Montana — Bureau Reclamation, Dpt. Interior, Bldg. 1-A, Denver Federal Center, Denver, Colo., furnishing, del. f.o.b. cars shipping point or f.o.b. cars Williston, N. D., three 115,000 volt-insulated, 69,000 to 66/155 volt, double-secondary, 60 cycle, oil immersed, outdoor potential transformers for Williston substation, Fort Peck Proj., Spec. 2244. Plans deposit 75c. Walker R. Young, Denver, ch. engr.

New Mexico—Bureau Reclamation, Dpt. Interior, Bldg. 1-A, Denver Federal Center, Denver, Colo., furnishing, del. f.o.b. cars shipping point or f.o.b. cars Tularosa, one 2,000-kva outdoor, package-type substation, for Hollywood substation, Rio Grande Proj., New Mexico-Texas, Spec. 2239. Plans deposit $1. Walker R. Young, Denver, Colo., ch. engr.

New Mexico-Texas—Bureau Reclamation, Dpt. Interior, Bldg. 1-A, Denver Federal Center, Denver, Colo., furnishing one 2,000 kva. outdoor, package-type stepdown substation, incl. high-voltage switching structure, 110-kv. power transformers, 15-kv switchgear for Hollywood Substation, Rio Grande Proj., New Mexico-Texas, Spec. 2239.

N. Y., Brooklyn—Hospital of the Holy Family, 155 Dean St., plans by Henry V. Murphy, 1 Hanson Pl., power plant, for hospital, 336-356 Pacific St. **$150,000.**

North Dakota—Bureau Reclamation, Dpt. Interior, Building 1-A, Denver Federal Center, Denver, Colo., three 115,000 volt insulated, outdoor potential transformers, Williston substation, Spec. 2244. Fort Peck Proj. Plans deposit 75c.

O., Shelby—City, 5,000 kw generator and condenser, house unit addn., equip. for municipal light plant. $400,000. Emery, Marker & Emery, Toledo Trust Bldg., Toledo, engrs.

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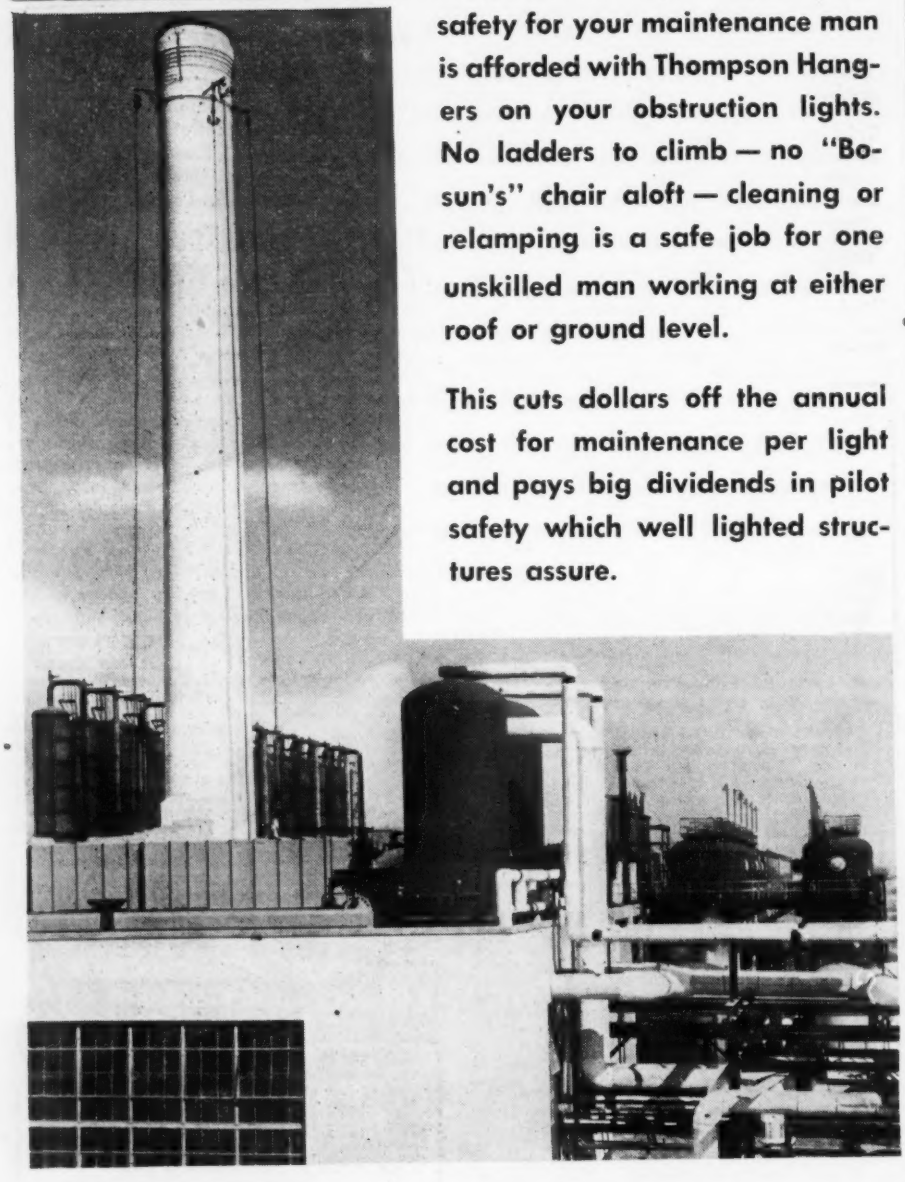

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Oklahoma—Rural Distribution Lines—North Fork Electric Co-operative, Sayre, labor for 303 mi. rural distr. lines, Beckham Co., to Bee Line Constr. Co., 1st Natl. Bldg., Oklahoma City. **$77,185.** Est. $85,000.

Texas—U. S. Eng., P.O. Box 1229, Galveston, design, manufacture and deliver f.o.b. railroad cars at Whitney Dam, installing in powerhouse and testing two 16,667 kva. alternating current generators and appurtenances for Whitney Power Plant on Brazos River near Hillsboro. Inv. No. Eng-41-243-48-327.

Washington—Bonneville Power Admin., 1300 N.E. Union St., Portland, Ore., 15.8 mi. Entiat River-Wenatchee River section Foster Creek-Snohomish 230 kv transmission line, Chelan Co.

Washington—Bureau Reclamation, Dpt. Interior, Building 1-A, Denver Federal Center, Denver, Colo., furnishing, del. f.o.b cars shipping point or f.o.b. cars Odair, one unit consisting 1 motor-switch-operating mechanism suitable for operating 1 type GK5, Form C, Bowie Air-break switch for 230 kilovolt left switchyard, Grand Coulee Power plant, Spec. 2240. Plans deposit 75c.

Wash., Sultan—Snohomish Co. Public Utility Dist., Everett, 310 ft. concrete dam across Sultan river to store water for power and water supply, 5 mi. tunnel and powerhouse. **$10,000,000.**

Wis., Menasha—Water & Light Comn., Menasha, 1 story, 109x122 ft., steel, brick power plant bldg., concrete fdn. Laramore & Douglass, Inc., 327 S. La Salle St, Chicago, 4, Ill., engrs.

Wyoming — Bureau Reclamation, Dpt. Interior, 318 New Custom House, Denver, Colo., transformers for substations at Glendo and Lusk, Missouri Basin Proj., Spec. 7-11.

Low Bidders & Contracts Awarded

Arizona—Bureau Reclamation, Dpt. Interior, Bldg. 1-A, Denver, Federal Center, Denver, Colo., Apr. 29, galvanized steel towers, appurtenances, etc. for Davis Dam-Hoover Dam, Davis Dam-Prescott and Prescott-Phoenix 230 kv transmission lines, Spec. 2165, from American Bridge Co., First National Bank Bldg., Denver, Colo. **$1,958,416.**

Texas—U. S. Eng., 606 Santa Fe Bldg., Galveston, furnishing, installing two 20,700 hp. hydraulic turbines, incl. embedded parts, appurtenances, Whitney Flood Prevention Dam on Brazos River, Inv. No. W-41-243-eng-48-229, to Newport News Shipbuilding & Dry Dock Co., Newport News, Va. **$530,510.**

Tex., San Antonio—Public Service Bd., 201 N. St. Marys St., generating unit in Leon Valley area outside city limits, own forces. **$175,000.**

INDUSTRIALS, COMMERCIAL & PUBLIC BUILDINGS

Proposed Construction

Calif., Los Angeles—Children's Hospital, 4614 Sunset Blvd., plans by Earl Heitschmidt & Charles O. Matcham, 449 S. Beaudry Ave., 12 story 300 bed hospital, remodeling present bldg. into 200 bed hospital, convalescent wing, training school, interns quarters, Type 1 bldg., steel. **$5,000,000.**

Tex., Conroe—Humble Oil & Refining Co., 1216 Main St., Houston, gasoline plant, and high propane recovery unit. **$5,735,000.**

Tex., Pickton—Humble Oil & Refining Co., 1216 Main St., Houston, natural gasoline plant. **$2,135,000.**

Low Bidders & Contracts Awarded

Ark., El Dorado—Lion Oil Co., T. H. Barton, Bd. Chn., design and construction anhydrous ammonia addn. to plant to Chemical Constr. Corp., 350 5 Ave., N. Y. Est. **$3,500,000.**

Ind., Hammond—Standard Oil Co., 910 S. Michigan St., Chicago, Ill., 3 story, brick, concrete engineering and administration bldg., to Geo. A. Fuller Co., 111 W. Washington St., Chicago, Ill. Est. **$5,000,000.**

Ia., Newton — Maytag Co., Newton, washing machine mfg. plant, to Arthur H. Neumann Constr. Co., 514 Hubbell Bldg., Des Moines. Approx. **$5,000,000.**